PAKISTAN COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH

BIENNIAL REPORT
1961 & 1962

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KARACHI
1964

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I

INTRODUCTION

INTRODUCTION

The first Quinquennial Report of the Council, which was published in 1959, gave a comprehensive account of the Constitution, objects and development of the Pakistan Council of Scientific and Industrial Research in the first five crucial years of its existence from 1953 to the end of 1958. A biennial report covering the years 1959 and 1960 has since been published, and the present volume forms the second biennial report in this series.

The broad object in establishing the Council was to initiate, promote and guide scientific and industrial research primarily directed towards the utilisation of the indigenous raw-materials, and the development of industries based on them. The specific means of achieving this aim, as laid down in the Constitution of the Council, included a wide range of activities such as making grants-in-aid towards research in universities and other research institutions, awarding research fellowships, encouraging industry to contribute to the research effort, and collecting and disseminating scientific and technical information. The most important means laid down for prosecuting the aims of the Council, however, consisted in the establishment and development of its own national research laboratories, in which research and development work could be carried out with the stated object of "utilising the economic resources of the country in the best possible manner".

While the organization of the Council is in general based on the pattern employed in pre-partition India, the distribution and functions of the laboratories in Pakistan have been planned with reference to the specific requirements and conditions of the country. Consequently the pattern of regional laboratories, each dealing with a range of pure and applied scientific subjects of importance to the region concerned, has been adopted, and the experience of the first seven years of their working has confirmed the appropriateness of this choice of pattern for the P.C.S.I.R. Laboratories. In particular, this choice has been the means of fostering a spirit of team-work between scientists of similar and allied disciplines, on which depends in great measure the success of most research projects.

DEVELOPMENT OF THE NATIONAL LABORATORIES

The plans in 1954 called for the establishment of four National Research Laboratories at Karachi, Dacca, Lahore and Peshawar, comprising in all about 20 research divisions. The inevitable difficulties of provid-

ing permanent laboratory accommodation, trained personnel, and essential equipment, apparatus, and chemicals have greatly affected the pace of their development, but already in 1958 the Central Laboratories at Karachi were well established in temporary premises of 50,000 sq. ft. with a scientific staff of about 100, while the East Regional Laboratories at Dacca and the West Regional Laboratories at Lahore, were also functioning, each with a scientific staff of about 35, including several foreign-qualified senior research workers. A small nucleus for the North Regional Laboratories had also been functioning in the Peshawar University Science Block.

During the years 1959-1960 and 1961-1962, all the four laboratories have substantially increased the strength of their scientific staff, and the present position with regard to premises and staff recruited is summarized below:

(1) *Central Laboratories:* Nucleus premises of over 50,000 sq. ft. equipped and in use during the last nine years. Also a Building Research Station was transferred from the Works Division three years ago. Construction of permanent buildings has been started, and the pilot-plant buildings and the three single-storey laboratories are already taking shape.

Scientific staff: 224, including 31 with foreign qualifications.

(2) *East Regional Laboratories:* The Nucleus had been functioning for six years in premises of 18,000 sq. ft. Permanent premises, with floor area of 60922 sq. ft., have now been equipped and are in use since early 1961.

Scientific staff: 105, including 25 foreign qualified research workers.

(3) *West Regional Laboratories:* Permanent premises with a floor area of 1,50,000 sq. ft. partially equipped and in use during last seven years. One of the blocks has been loaned to the Atomic Energy Commission for housing the nucleus of their laboratory.

Scientific staff: 117, including 9 foreign qualified research workers.

(4) *North Regional Laboratories:* The Nucleus of the premises had previously been functioning in the Science Block of the Peshawar University for five years. The premises have been shifted to the permanent buildings which are now fairly well equipped.

Scientific staff: 76 of whom 9 possess foreign qualifications.

PROGRESS OF RESEARCH WORK

The research activities of the Council cover a wide range of problems and comprise laboratory investigations in pure and applied field, followed in most cases by pilot plant studies on the economics and optimum working conditions of the process developed in the laboratory, before they are leased out to industrialists for commercial exploitation. Without such pilot plant studies, the industrial exploitation of any new discovery or improvement in a manufacturing process is not paracticable, particularly in the present stage of our industrial development with all its short-comings in the production of goods acceptable to the consumers. It has been found expedient in many cases to set up semi-scale production units in the P.C.S.I.R. Laboratories for supplying large quantities of products for consumer testing and approval.

Applied Researches: The years 1961 and 1962 have seen an accelerated pace of development in respect of successful commercial utilization of the pilot projects. During this period, the following processes went into commercial production (1) Shark liver oil and vitamin 'A' concentrate; (2) Petrol Gas plant; (3) 'Cemto', an integral water-proofer for cement; (4) Dried slaughter house blood; (5) 'Balcrete', an air entraining agent for foam concrete; and (6) Fountain pen writing ink.

The following items were produced on pilot plant scale and sold in considerable quantities for consumer testing: (1) 'Balcrete', 40,000 lbs., (2) 'Fixempero', a gypsum based dry distemper, 8,000 lbs., and (3) 'Cuprex', a wood preservative, 3,000 lbs. In addition, a few more processes have been leased out and are in various stages of development.

During the two years covered in the present report, several other products have reached the pilot plant stage: (1) Makrolin, on which small pilot studies have been successful and a large pilot plant is soon to be imported for pilot production and consumer testing; (2) 'Marbolite', a synthetic marble based on the minerals, barytes and celestite; (3) Manufacture of paper pulp and acetatic silk from jute sticks; (4) Cottage-scale production of 'sago' from maize starch (5) A composition for integral water proofer for concrete in liquid form; (6) Hydraulic cement based water paints; and (7) Domestic water filters. Altogether, eleven patents have been obtained, while application for four more are pending in the Patent Office.

Fundamental Studies: A brief reference may be made in this connection to some important research programmes that are presently engag-

ing the attention of the Council's scientific staff. In view of the promising results obtained with the extraction of Rauwolfia roots in a fresh undried state, several medicinal plants are being re-investigated along these lines. Particular mention may be made of 'harmadine' isolated from *Peganum harmala*, which has been found even in very low doses to give protection against gamma radiations. Studies in the correlation of cardiac action with chemical structure in the Ajmaline series of bases are also being actively pursued.

In the Physical Research Division, the studies on viscosity and intermolecular activation energy have led to the discovery of a definite fine structure of energy level. These studies are now being extended to other properties like thermal expansion and refractive index, and some exciting new results are appearing.

Long-Range Problems: Some of the important long-range researches of vital national importance that have engaged the attention of the Council are (1) Beneficiation of indigenous iron ores from Kalabagh and Ziarat; (2) Production of insecticides from indigenous raw materials; (3) Utilization of jute sticks and other agricultural wastes; (4) Development of alkaloids and alkaloidal complexes of Rauwolfia—Ajmaline and Serpajmaline for treatment of Cardio -Vascular diseases; (5) New applications of indigenous minerals. The last one in particular has already yielded striking results, e.g. gypsum has been used as a main constituent for a new type of distemper and barytes and celestite for the production of 'Marbolite'—a synthetic marble.

PUBLICATION AND DOCUMENTATION

The research work of the Council is being published in a number of scientific journals. Since 1958, the Council has been taking out its own quarterly "Pakistan Journal of Scientific and Industrial Research", which also accepts papers from the Universities, Research Institutes and other organisations. A list of papers, totalling 119 published by workers in the Council's laboratories during the two years under review is given in Appendix.

The Council has also started to bring out a popular science journal, the monthly "Science Chronicle", with the object of popularising science amongst the intelligent reading public in the country.

The Pakistan National Scientific and Technical Documentation Centre (PANSDOC) set up in 1957, with the object of providing dissemination of scientific and technical information throughout Pakistan, has made con-

siderable progress during these two years. It has now a sub-office at Dacca at the regional laboratories of the Council. Photo-offset press is under installation and will shortly be able to handle all the printing jobs of the Council's publication in addition to its own. In general, the facilities of PANSDOC have expanded considerably and it is now co-operating with the University of Karachi in providing instruction and giving training in Scientific Documentation, leading to the Master's degree in Library Science. PANSDOC can now handle translations in French, German, Spanish, Italian, Russian, Bulgarian Byclorussian and Ukranian. During the period under review, PANSDOC received 4568 requests for the compilation of bibliographies, procurement of microfilm or photocopies and for translation of papers.

OTHER ACTIVITIES

The Council can also take credit for many other activities directed towards the industrial development of the country and towards enhancing the utilization of the scientific and technical manpower. It has been functioning as a scientific advisory body to the Government and private sector in the industrial and other related fields. This aspect is discussed in detail under the chapter "Scientific and Industrial Liaison".

In accordance with the recommendations of the Scientific Commission of Pakistan, which had been set up in 1959 as a result of initiative taken by P.C.S.I.R., the National Science Council was constituted in 1962. The first meeting of the National Science Council was held on 9th April, 1962 under the Chairmanship of Dr. Salimuzzaman Siddiqui. In the initial stages, the major responsibility of the National Science Council will be to lay down broad policies relating to the research programme of the constituent research councils, the co-ordination of their activities and in certain measure the scientific effort of the country as a whole. The re-organisation of the Medical Research Council (in accordance with recommendations of the Scientific Commission) has already been notified by Government of Pakistan. The revised constitutions of the P.C.S.I.R. and of the Atomic Energy Commission have been finalised and submitted to the Government. The Agricultural Research Council and the Council of Irrigation and Works are still working on the revision of their constitution. Certain recommendations of Scientific Commission such as scales of pays for the scientists of the various Science Councils are as yet being examined for possible implementation.

FUTURE DEVELOPMENTS

Among the more important projects planned for the following years are: (1) Studies in the Chemical methods of beneficiation of indige-

nous iron ores; (2) Use of Sui-gas for (*a*) direct reduction of iron ores (*b*) up-grading of indigenous coals (*c*) reduction of barytes for production of lithopone and barium chemicals; (3) Extraction of curcumin from turmeric; (4) Preparation of concentrates for use in aerated drinks; (5)Utilization of clifton sand for production of thermal insulating materials; (6) Studies on the water proofing of concrete and development of a water proofing composition in liquid form; (7) Ready to use artificial stone facing materials; (8) Improvements in the sulphate resistance properties of Portland cement concrete by (*a*) addition of minerals and pozzolanas (*b*) air-entrainment; (9) Utilization of jute sticks for (*a*) paper pulp and rayon (*b*) insulation boards; (10) Studies in natural resins (*a*) oxidation resistant rosins (*b*) modification of Shellac; (11) Ready to lay paper based bituminised roofing materials; (12) Extraction of Vitamin B_1 concentrate from rice husk; (13) Fish meal, cottonseed and guar seed, flours as a source of low cost proteins for human food; (14) Studies in electrical insulation materials; (15) Studies in the production of meta-silicate for use in detergents and textile finishing; (16) Fatty acids-betulin condensation products; (17) Bone gelatine and Bone phosphate (18) Production of algae as human food; (19) Rubber lining of the process equipments; (20) Anti-anemic preparation of trace elements.

Scientific research and development call for a prolonged study, needing patient and persistant effort and it is only by stages and in the fullness of time that we can hope to tackle successfully the many and varied scientific and technological research problems of the country. It has, therefore, to be stressed that scientific achievements are in the nature of things, a matter of gradual stage-wise progress and a greater attention needs to be paid towards building up an effective research potential. While laying stress on the applied side of research, considerable amount of research work at P.C.S.I.R. has been directed towards better utilization of indigenous raw materials and saving considerable amount of foreign exchange for the country. This would be of the order of Rs. 15,000,000 when the processes already leased out are in full production. This aspect is discussed in detail under the chapter "Patents and Research Utilization". Another aim of the P.C.S.I.R. has been to carry the fruits of research to public as soon as possible. In this respect, Council has been very successful and has already 8 processes under commercial production. If the Government can see its way to remove some of the bottle necks in respect of foreign exchange allocations and a fair provision of funds, particularly for the purchase of pilot plant equipment, a great deal more can be done to achieve the objectives the P.C.S.I.R. has set before itself.

II

ORGANISATION OF THE COUNCIL

ORGANISATION OF THE COUNCIL

The Pakistan Council of Scientific and Industrial Research is an autonomous body registered under the Societies Act of 1860. It is responsible for the administration of the Research Fund to which grants are made by the Government of Pakistan from year to year.

The Council enjoys full freedom in the planning of its research programme, and has an anchorage in the Government through the Department of Scientific and Industrial Research within the Ministry of Industries. The Director of the Department is *ex-officio* Chairman of the Council. The Department takes care of the more representative functions and co-ordinates the Council's work with the research going on under the auspices of other Ministries or Departments.

GOVERNING BODY

The administration of the Council is vested in the Governing Body, of which the Minister for Industries, Government of Pakistan, is the President. The Governing Body has 23 members, including of course, the Minister for Industries, representatives of the Central and Provincial Governments, eminent scientists and industrialists.

The management of the affairs, funds and revenues of the Council is vested in the Governing Body, subject to such general directions in respect of expenditure as the Central Government may issue from time to time. All decisions on matters of policy, budget allocations, sanctioning grants for specific research schemes and other matters falling within the scope of the activities of the Council are taken by the Governing Body. The President of the Council is vested with wide financial powers within the sanctioned budget allocations.

The Governing Body in turn is responsible to the Council, which consists of 36 members composed of representatives of the Central and Provincial Governments, eminent scientists, industrialists and educationists.

The term of office of the members of the Governing Body, as well as the Council, is three years.

ADVISORY BODIES

A standing advisory body, viz, the Central Planning Committee of the Council, advises the Governing Body on all matters relating to the planning and construction programme of the laboratories, and on general technical and policy matters. It consists of 8 members nominated by the Governing Body.

The Central Planning Committee has also been charged by the Governing Body with the responsibility to function as the Research Utilization Committee in respect of the leasing out of the processes evolved under the Council for large scale commercial development.

The Governing Body has also constituted six Research Advisory Committees. The Chairman of Scientific and Industrial Research is an *ex-officio* member of each of these Committees. All research schemes submitted to the Council by Universities or other research institutions for grant-in-aid are referred to the appropriate Research Committee for scrutiny and recommendation. The six Research Committees are: (1) Chemical Research Committee; (2) Drugs, Pharmaceuticals and Pest Infestation Research Committee; (3) Industrial Fermentation and Biological Products Research Committee; (4) Building Research Committee; (5) Fuel Research Committee; and (6) Physical Research Committee.

ADMINISTRATION

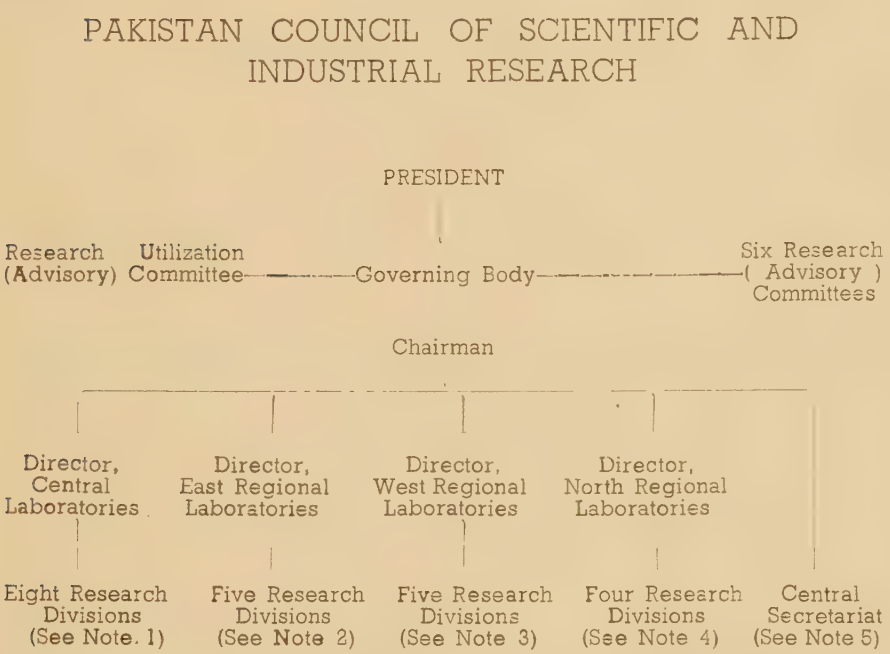
The Chairman of Scientific and Industrial Research is the principal executive officer of the Council. He is responsible for the day-to-day administration of the Council, and exercises supervisory control over its technical and research activities, including the work of the Central and the Regional Laboratories and research under the grant-in-aid schemes. He is a member of the Council and also of the Governing Body, the Advisory Bodies, and the Council's Selection Board (which is responsible for making higher appointments), and is Chairman of the Council's Selection Committee.

REGIONAL LABORATORIES

The direction of scientific research and the day-to-day administration of the regional laboratories is vested in the Directors of the respective laboratories. The scientific work of the laboratories is carried out in the various divisions under the guidance of the Heads of Divisions. The Registrars or Administrative Officers look after routine administrative and financial matters.

ORGANISATIONAL CHART

The following chart depicts the inter-relationship of the various units under the Council of Scientific and Industrial Research.


PAKISTAN COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH
PRESIDENT
Research (Advisory) Committee
Utilization
Governing Body
Six Research (Advisory) Committees
Chairman
Director, Central Laboratories
Director, East Regional Laboratories
Director, West Regional Laboratories
Director, North Regional Laboratories
Eight Research Divisions (See Note. 1)
Five Research Divisions (See Note 2)
Five Research Divisions (See Note 3)
Four Research Divisions (See Note 4)
Central Secretariat (See Note 5)

Note (1) Central Laboratories. Research Divisions are (1) Physical Research and Testing, (2) Chemical Research, (3) Biochemical Research, (4) Drugs and Pharmaceuticals Research, (5) Building Materials Research, (6) Fuel Research, (7) Paints and Plastics Research, (8) Engineering Research.

Note (2) East Regional Laboratories. Research Divisions are (1) Leather Research, (2) Fuel Research, (3) Glass and Ceramics Research, (4) Food and Fruit Technology, (5) Plant and Animal Products Research.

Note (3) West Regional Laboratories. Research Divisions are (1) Metallurgical (including Ore dressing and testing of minerals), (2) Industrial Fermentation Research, (3) Oils and Fats Research, (4) Food Technology Research, (5) Glass and Ceramics Research.

Note (4) North Regional Laboratories. Research Divisions are (1) Indigenous Drug Research, (2) Fruit Technology Research, (3) Wool Research, (4) Mineralogical Research.

Note (5) Central Secretariat responsibilities are (1) Meetings of Council, Governing Body and Advisory Bodies; (2) General and Policy Matters; (3) Finances; (4) Research Schemes; (5) Dissemination of Scientific and Technological Information; (6) Patents and Publications; (7) Awards of Fellowships and Scholarships; (8) Research Utilization; (9) Planning and Construction.

III

DEVELOPMENT OF NATIONAL LABORATORIES

DEVELOPMENT OF NATIONAL LABORATORIES

On the recommendations of the Planning Committee constituted by the Governing Body of the Pakistan Council of Scientific and Industrial Research, a plan was approved in 1953 for the establishment of four National Laboratories under the Council, viz. the Central Laboratories at Karachi and three Regional Laboratories at Dacca, Lahore and Peshawar, to take care of industrial problems specific to these areas. Each of these four laboratories now comprises a number of Research Divisions with special reference, in case of the Regional Laboratories, to the needs of the areas they principally serve.

CENTRAL LABORATORIES, KARACHI

(1) Physical Research and Testing Division;

(2) Chemical Research Division;

(3) Biochemical Research Division;

(4) Drugs and Pharmaceuticals Research Division;

(5) Building Materials Research Division;

(6) Fuel Research Division;

(7) Paints and Plastic Research Division; and

(8) Engineering Research Division.

EAST REGIONAL LABORATORIES, DACCA

(1) Plant and Animal Products Research Division (covering work on minor forest products, and biological, agricultural and industrial wastes);

(2) Fuel Research Division (principally for work on the peat and lignite coal deposits of the area);

(3) Food and Fruit Technology;

(4) Leather Research Division (principally providing facilities for investigations on the tanning material resources of the region); and

(5) Glass and Ceramics Research Division.

WEST REGIONAL LABORATORIES, LAHORE

(1) Ore Dressing and Metallurgical Research Division;

(2) Industrial Fermentation Research Division;

(3) Oils and Fats Research Division;

(4) Glass and Ceramics Research Division; and

(5) Food Technology Research Division.

NORTH REGIONAL LABORATORIES, PESHAWAR

(1) Indigenous Drugs Research Division;

(2) Fruit Technology Research Division;

(3) Wool Research Division; and

(4) Mineralogical Research Division.

In deciding on the ultimate location of the laboratories, utmost consideration has been given to placing them in the vicinity of the Universities in order to facilitate closest possible co-operation between the laboratories of the Universities and the Council. While such close association can be of mutual benefit in any country, it is positively imperative in Pakistan for ensuring an overall co-ordinated progress of scientific teaching and research, inspite of our comparative shortage of scientific and technological personnel.

THE CENTRAL LABORATORIES, KARACHI

Present Buildings and Equipment: The Central Laboratories are at the moment housed in the converted barracks belonging to the Pakis-

tan Naval Hospital. The total covered area is about 50,000 sq.ft. Since the number of scientists has considerably increased in the last few years, more apparatus and capital equipment has been purchased so as to keep pace with the growing needs of these laboratories. The Pilot Plant Station and the Building Research Station, added to the Central Laboratories in in 1959, have shown considerable progress both in respect of staff and equipment on one hand and output on the other.

Personnel: While the Chairman of the Council looks after the over all administration of the laboratory, the individual divisions are controlled and directed by the Heads of Division and Principal Scientific Officers, who have under them a number of qualified research workers of long standing including several with foreign qualifications. The present distribution of research staff over the individual divisions is shown below:

Research Units	Heads of Division	Principal Scientific Officers	Senior Research Officers	Research Officers	Research Physicists Chemists etc.	Technical Asstt.	Senior Lab. Asstt. and Technicians
Physics	1	—	3	3	7	18	9
Chemistry	1	—	5	—	4	35	13
Biochemistry	1	—	2	1	1	11	1
Biological Evaluation	—	—	1	—	4	13	7
Drugs and Pharmaceuticals	—	—	2	1	5	8	6
Pharmacology	—	—	2	5	3	1	—
Fuel	—	—	1	—	3	5	—
Building Materials	—	—	1	—	2	1	2
Paints and Plastics (including Tanning)	—	—	1	2	3	5	8
Chemical Engineering and Pilot plant	1	—	1	4	1	4	5
T o t a l	4	—	19	16	33	101	51

The above research staff is helped and assisted by a considerable number of B. Sc.'s, who are unable to continue their studies for one reason or the other. Besides, a number of Laboratory Assistants, recruited from amongst people with good technical know-how but poor academic qualifications, are also employed in the various sections of the laboratory.

Auxillary Services: (*i*) The library service has substantially increased during the years under review. The library now has nearly 12,000 volumes on its shelves and subscribes to 267 journals. In addition, it received 100 periodicals either in exchange or as gifts from abroad.

(*ii*) The Stores occupy an area of 12,000 sq. ft. and hold a total of 13,000 different items on the stocks, valued at Rs. 70 lakhs, including the equipment issued to the laboratories. Of this total value, Rs. 44 lakhs correspond to scientific equipment, Rs. 21 lakhs to glassware and delicate apparatus, and Rs. 5 lakhs to chemicals. The Stores are managed by an Assistant Stores Officer, who is aided by a Stores Supervisor, one Senior Store-keeper and two Store-keepers. There are in addition two Assistant Store-keepers for the sub-stores.

(*iii*) The Office of the Central Laboratories looks after the administration, accounts and local purchases for the various divisions of the laboratories and is headed by an Administrative Officer, aided by an Assistant Administrative Officer and four Superintendents.

Permanent Laboratory Buildings: The permanent buildings of the Central Laboratories of the Pakistan Council of Scientific and Industrial Research are being built on a 150 acre plot, allotted by the Government adjacent to the Karachi University campus on the Country Club Road, about ten miles inland from Karachi. These will comprise several single-storey laboratories and one three—storey block for Pansdoc, Administration and two of the Research Divisions. These buildings are expected to be available for occupation in a year or two. Some details are given below:

(i) Laboratories Blocks: (*a*) Pilot plant and workshop building-with a plinth area of 32,640 sq. ft. has been built at a cost of about Rs. 4.35 lakhs; (*b*) Chemical Research Division—with a plinth area of 18,100 sq. ft. at an estimated cost for structural work of about Rs. 22 lakhs. The construction work has been completed up to roof level; (*c*) Paints and Plastic Research Division—with a plinth area of 15,860 sq. ft. at an estimated cost for structural work of Rs. 2.0 lakhs. The construction

work has been completed upto roof level; and (*d*) Building Materials Research Division—with a plinth area of 15,860 sq. ft. at an estimated cost for structural work of about 1.9 lakhs. The construction work has been completed upto roof level.

(ii) Staff Quarters: The following staff quarters have been consttructed (*a*) 12 Nos. 'F' type quarters; (*b*) 12 Nos. 'E' type quarters; (*c*) 7 Nos. 'D' type bungalows; (*d*) 1 No. 'B' and 2 Nos. 'C' type bungalows; and (*e*) 20 'G' type quarters.

(iii) Internal Water Supply Scheme: (*a*) Water supply line for the over head tank has been completed; and (*b*) 85% of the construction work on 50,000 gallons overhead tank has been completed.

(iv) Roads (Internal): Nearly 90% of the work on the first phase of road construction has been completed.

(v) Development: Considerable amount of work on the roadside plantation and development of some of the proposed lawns has been completed.

EAST REGIONAL LABORATORIES

The East Regional Laboratories have shifted from their temporary home at the Polytechnique Institute, Tejgaon, to the newly constructed building on their own premises at Mirpur Road, Dhanmondi, Dacca, where residential quarters for some of the Laboratory Staff have also been constructed. For the present three Research Divisions have been accommodated in the Food and Fruit Technology Building and the remaining two in the Glass and Ceramic Building.

In addition to the main blocks, construction of three Godowns, boundary wall, compound road, animal house, water tower, electrical sub-station and workshop has also been completed. The estimated expenditure for construction is about Rs. 45 lacks.

These Laboratories have been suitably furnished and equipped with fittings and fixtures in the most up-to-date manner with electricity, running water and gas. In respect of scientific equipment, apparatus including instruments and appliances for laboratory works, the position is fairly satis-

factory. The number of Research Workers have also increased and the position in respect of personnel is given below:

Personnel:	At the end of 1960	At the end of 1962
Director	1	1
Heads of Division	1	2
Principal Scientific Officers	2	2
Senior Research Officers	5	9
Research Officers	2	10
Research Chemists, Physicists etc.	4	17
Technical Assistants	33	50

WEST REGIONAL LABORATORIES

Permanent Buildings: Out of 100 acres of land obtained as a gift from the West Pakistan Government, about 75 acres, which lay on the eastern side of Ferozpur Road had been initially taken possession of and construction started thereon. Accordingly, the Food Technology, Glass and Ceramics and Pilot Plant Blocks had already been constructed and various Research Divisions accommodated therein. The procurement of the remaining 25 acres of land is being pursued.

Workshop has been shifted to its new building from the previous block, which is now being used to house a co-operative store, a staff club and the office of Pakistan Association of the Advancement of Science. Accomodation for a post office and a canteen has also been provided. Consttruction of roads around the campus has been completed.

The following staff quarters were constructed during the two years under review (1) 1 No. Bungalow for Head of a Division (2) 5 Nos. 'C' type, 8 Nos. 'D' type bungalows (3) 30 Nos. 'E' and 'F' type (4) 6 Nos. 'G' type quarters.

Equipment: During the two years under review, some of the much needed equipment worth Rs. 2,23,000.00 was received. In addition purchases from within the country were also made to meet growing needs of the scientific personnel of the laboratories.

Library: The library service has substantially increased during the years under review. The library subscribes to 3 Pakistani and 120 foreign

journals. Scientific and technical books valued at over Rs. 20,000 were added to the existing bulk of the stock.

Personnel: The situation with regard to research staff has improved during the two years covered by this report. While three research workers returned from abroad after completing training, more than a dozen research workers proceeded for training on scholarships, fellowships, *bursaries* under Colombo Plan, FAO and other schemes, on assistantship or on study leave. The total number of research workers under training abroad exceeds twenty at the end of the two years under review. Three foreign-qualified research workers joined these laboratories during 1961, and the services of Mr. Miller, a well known nutritional expert were acquired for a period of two months for helping us in setting up the laboratories for the Food Division.

The comparative figures of staff at the end of 1960 (the end of the period covered by the first biennial report) and 1962 are given below:

	At the end of 1960	At the end of 1962
Director	1	1
Heads of Division	—	1
Principal Scientific Officers	1	—
Senior Research Officers	6	7
Research Officers	4	7
Research Chemists, Physicists etc.	4	15
Technical Assistants	52	88

NORTH REGIONAL LABORATORIES

Permanent Buildings: As mentioned in the last Biennial Report, (1959 and 60) construction of the four wings of the laboratories meant to accommodate four research divisions was completed and the equipment in the original site in the Biological Block of the Peshawar University was shifted to the new premises.

Construction of one of the main blocks, for accommodating the Office, Library, Museum, Auditorium etc. has been completed at a cost of about Rs. 8.7 lakhs during the years under review. The basic structure for the Pilot Plant Building was also put up and the work completed at

a cost of about 3 lakhs. The construction of a part of Administrative Block and 6 Nos. 'F' type quarters is in progress. The following residential accomodation near the laboratories blocks has so far been constructed: (*a*) Bungalow for Head of the Division 1; (*b*) Senior Research Officer's Bungalows 3; (*c*) Research Officer(s) Bungalows 6; (*d*) Research Chemists/Physicists/Biologists Bungalows 6; and (*e*) 'G' type quarters (including quarters for Class IV servants) 29.

These Bungalows and Quarters have been constructed at an approximate cost of Rs. 2.6 lakhs.

Equipment: During the two years under review, some of the much-needed equipment for the four research divisions as also some spare parts and accessories (for equipment already in use) were received, the total cost being Rs. 1,35,700.00. Chemicals worth Rs. 75.725.00 were purchased for use in the laboratories.

Library: At present the library has on its shelves a total of 3578 books valued at about 1.22 lakhs. Besides, 969 journals are subscribed and 241 received as gifts

Scientific Staff: The position of the Scientific staff is as follows:

	At the end of 1960	At the end of 1962
Director	1	1
Principal Scientific Officers	—	1
Senior Research Officers	2	2
Research Officers	1	9
Research Chemists, Physicists etc.	3	9
Technical Assistants	11	25
Senior Laboratory Assistants and Technicians	—	27

IV

ABSTRACTS OF RESEARCH WORK CARRIED OUT AT THE P.C.S.I.R. CENTRAL LABORATORIES

CENTRAL LABORATORIES

PHYSICS AND PHYSICAL CHEMISTRY

1. X-RAY STRUCTURAL INVESTIGATIONS: (*a*) PHYSICO-CHEMICAL STUDIES OF INDIGENOUS IRON ORES: In continuation of earlier work done in these laboratories, investigations have now been carried out on samples of iron ore from Ziarat (Baluchistan) and a report has been supplied to the Geological Survey of Pakistan. Collaborative investigations on the complete analysis, beneficiation and reduction of ore from this locality as well as from the Chichali area of the Kalabagh ore-field are also in hand.

Project Associates: R. A. Shah, M. Sualeheen, S. H. Rizvi and M. M. Qurashi.

(*b*) ROUTINE X-RAY ANALYSIS: This activity, which covers identification of mixtures and compounds for other divisions of the laboratories is being carried on, and a file of standard powder patterns has been started.

Project Associates: M. Sualeheen and M. M. Qurashi.

(*c*) STRUCTURAL AND DEHYDRATION STUDIES ON METAHEWETTITE AND OTHER MINERAL VANADATES: These studies were begun some years ago in Canada, and are now being carried a stage further inorder to elucidate the precise forms of the vanadium-oxygen coordination polyhedra in the presence of other cations (*viz.* calcium, lead, manganese, sodium). In some of these structures, it has been found that the atoms are located at or displaced slightly away from positions of "super-symmetry", and a new method is being developed for the determination of these small displacements, using the intensities of reflections forbidden by the super-symmetry.

Publication: 'The Polymorphism and Hydration Characteristics of Hewettite and Metahewettite' by M. M. Qurashi, *Canadian Mineral.*, **6** part 5, 647 (1961).

2. STUDIES IN THE RELATIONSHIP BETWEEN VISCOSITY AND MOLECULAR STRUCTURE: The experiments carried out in these laboratories on this subject have proved very rewarding of late, leading to the discovery of sharp jumps in the inter-molecular energy of activation for flow in various

liquids such as ethylene glycol and water. These jumps seem to occur at regularly spaced intervals of temperature, and could indicate some periodic changes of structure within the liquids.

It has, therefore, been considered worthwhile to extend these studies to include simple binary systems like aqueous solutions of hydroxylic liquids, the viscosity measurements being made to an accuracy of 1 part in 20,000 with temperature control to 0.002°C. In this way, it is hoped to obtain further insight into the character and cause of these energy jumps through variation of the concentration. It has been found that these jumps change in magnitude and position as the concentration of the solute is varied, and a detailed study of the phenomenon is being made.

Work is also continuing on further refinement of the measurements on pure liquids like water, previously published from this laboratory, and derivatives of other physical properties are also being taken up for investigation.

Publications: (*i*) 'Investigation of Periodic Discontinuities in the Mutual Potential Energy of Molecules of Water and some Polyhydric Alcohols' by M.M. Qurashi and A.K.M. Ahsanullah, *British J. Appl. Phys.* **12**,65 (1961). (*ii*) 'Temperature Dependence of the Intermolecular Activation Energy for Flow in Liquids and Solutions-Part I' by A.K.M. Ahsanullah, S. Rahmat Ali, and M.M. Qurashi, *Pak. J. Sci. Ind. Research* **5**, 133 (1962). (*iii*) 'Temperature Dependence of the Intermolecular Activation Energy for Flow in Liquids and Solids—Part II' by M. M. Qurashi, *Pak. J. Sci. Ind. Research* **5**, 143 (1962). (*iv*) 'Investigation of Fine-structure in the Steps observed in the Intermolecular Activation Energy of Viscous Flow of Ethylene Glycol' by A. K. M. Ahsanullah and M.M. Qurashi, *British J. Appl. Phys.*, **13**, 334-344 (1962).

3. Studies in the Influence of Phenolic Additives on the Viscosity of Straight-chain Oils: In the previous work described in earlier reports, it has been found that a significant viscosity depression was obtained, even when dimethoxy-bhilawanol and allyl benzene (both compounds with no free hydroxylic groups) were mixed with light mineral oils. This observation prompted a study of simple binary systems like benzene-heptane, toulene-octane, and phenol-mineral oil.

Since the temperature provides a third variable for study of the energetics of the systems, it has been considered worthwhile to carry out experiments on each system at a series of closely spaced temperatures, and the results obtained are being analysed. The phenol-mineral

oil system shows partial miscibility below 80°C, and this makes it particularly suitable for examining aggregation phenomena occuring near the miscibility limit.

Publication: 'The anomalous Behaviour of Solutions of simple Aromatic Compounds in Straight-chain Hydrocarbons and Mineral Oils-Part I', by M. Tayyab Qureshi and M. M. Qurashi, *Pak. J. Sci. Ind. Research* **5**, 222 (1962).

4. Study of Insulation Resistance and Dielectric Properties of various Materials: Following upon some earlier measurements carried out on samples of insulating varnish and "jutoid", a systematic investigation has been taken up on the dielectric and insulation properties of several naturally occuring and synthetic materials under various conditions of humidity and temperature.

It is found from relatively simple measurements of conductivity at various applied field strengths that the influence of absorbed water is very important, and it appears that there are two components of the electrical conductivity, one of which is independent of applied field and the other seems to vary linearly with the field. The dependence of these components on water content is being studied.

Publications: (*i*) 'Observations on the Voltage Dependence of the Insulation Resistance of some Insulating Materials' by S. N. Ahmad and M. M. Qurashi, *Pak. J. Sci Ind. Research* **4**, 49 (1961).

(*ii*) 'Studies in the Electrical Insulation of Natural and Synthetic Materials-Part I' by M. K. Husain, Gazimuddin, F. Shaikh and M. M. Qurashi, *Pak. J. Sci. Ind. Research* **5**, 267 (1962).

5. Investigations on the Electrical Properties of Cottonseed Cake and various Hydrated Compounds: In the course of experiments conducted to develop a non-destructive electrical method for estimating the oil-content of a single cotton-seed, it was found that the dielectric constant and electrical conductance of cottonseed cake are extremely sensitive to water content. The dielectric constant rises 50-fold for an addition of 15% water. The dependence of dielectric constant and conductance on the percentage water content is found to be exponential, which is most unusual.

These observations led us to take up a general study of the electrical properties of hydrated compounds, and some preliminary experiments are in progress in these laboratories. The simple technique of enclosing a

sample of the powdered compound between the plates of a parallel-plate condenser, and then measuring the capacitance and conductance with a 10 kilo-cycle bridge is presently being used. However, considerable difficulties are encountered with surface-film effects.

Publication: 'An Investigation of the Influence of Humidity and Water Content on the Electrical Properties of Cottonseed Cake' by A.K. Bhuiyan and M. M. Qurashi, *Pak. J. Sci. Ind. Research* **4**, 29 (1961).

6. Testing of some Acoustical Building Materials: A small acoustical laboratory is being set up for the testing and development of building materials and wall panels suitable for acoustical treatment of auditoria and other buildings, where special acoustical characteristics are needed.

Project Associates: Fakhruddin Shaikh, S. N. Ahmad and M. M. Qurashi.

7. Development of Blue-black and Special Inks: Two different types of fountain pen inks were developed at the request of some Government agencies, so as to give the specific properties desired by them.

A small pilot plant was set up and has been rented out for the production of fountain-pen ink according to our prevously developed process.

Project Associates: R. A. Siddiqui, and S. A. K. Lodhi.

8. Gamma Ray and Neutron Absorption in Materials: Alongside of the development of special compositions in the Building Material Division of the Central Laboratories, it was considered desirable to institute a testing programme covering gamma ray and neutron absorption measurements in existing building materials as well in those currently being developed.

A counting arrangement with variable geometry has been set up and a few small sources have also been installed. Some measurements on various types of concretes, on gypsum and several new building materials have already been obtained.

Project Associates: Z. Haider, M. K. Husain and F. Shaikh.

9. *Other Publications:* (*i*) 'The Design of a Simple Uranium-Thorium Discriminator for Weakly Active Ores Containing less than 1% U_3O_8 Equivalent Part II—Design, Use and Testing of Discriminator' by M.K. Husain, M. Azeem and M. M. Qurashi, *Pak. J. Sci. Ind. Research* 4, 93 (1961).

(*ii*) 'The Utilization of Scientific Research' by S. Siddiqui, M. M. Qurashi and A. H. Chotani, *Pak. J. Sci. Ind. Research*, **4**, 76 (1961).

INORGANIC AND ANALYTICAL CHEMISTRY

1. Determination of Nitrogen in Organic Compounds using Ion Exchange Resin: The nitrogen in organic compounds is determined by decomposing the sample in a sealed tube and passing the digest through two columns of anion exchange resin, placed one above the other. The top column contains the resin in the (OH) form and the lower column in the iodide form. The ammonium sulphate on passing through these two columns is converted into NH_4I,

$$(NH_4)_2SO_4 \xrightarrow[IR\ 400\ (OH)]{\text{Ist. Column}} NH_4OH$$

$$NH_4OH \xrightarrow[IR\ 400\ (I)]{\text{IInd. Column}} NH_4\ I$$

which is determined by Lieperts amplification procedure, which enhances the accuracy of the method six-fold. The application of the method to nitro and azo compounds after reduction with glucose is being studied. A paper has been sent for publication.

Project Associates: R. A. Shah and A. H. Qadri.

2. Chemical Examination of Quality of Kalri Lake Water for Irrigation: The Kalri lake is located 7 miles from Thatta. It was reported that the lake water, besides causing water logging, lacked in certain attributes essential for crop growth. It was believed by the public as well as administrative authorities that this water could not be used for irrigation, and measures were being suggested to dry up the lake. Realising the seriousness of the problem, the present investigations were undertaken to make an exhaustive chemical examination of the lake water with a view to assessing its quality for irrigation purposes.

Sodium, Calcium, Magnesium, Boron chloride, Carbonate, Bicarbonate and Sulphate contents, and electrical conductivity of representative samples of Kalri lake water from several locations were determined. These and similar data were collected from the Kalri Baghar Feeder. The data obtained had been presented in this communication. This investigation led to the conclusion that the lake water on the whole was fit for irrigation purposes. A paper has been accepted for publication.

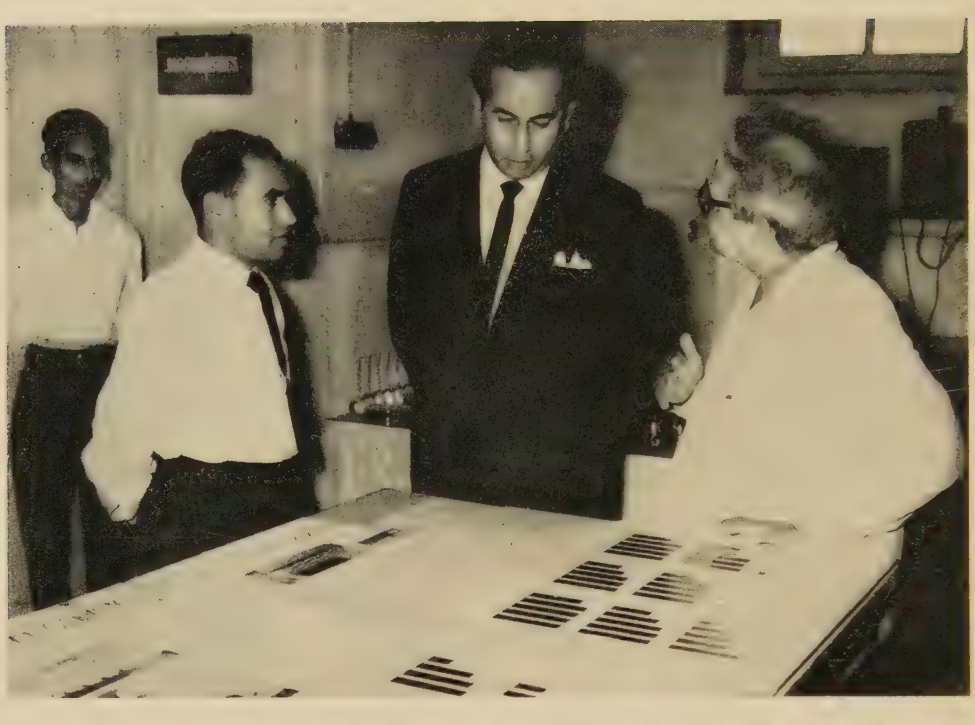
Project Associates: R. A. Shah and Tahir Reza.

Dr. Salimuzzaman Siddiqui, Chairman, Pakistan Council of Scientific and Industrial Research.

Dr. Mohammad Qudrat-i-Khuda, Director, East Regional Laboratories, Dacca.

Dr. Karimullah, Director, West Regional Laboratories, Lahore.

Dr. S. A. Warsi, Acting Director, North Regional Laboratories, Peshawar.



Mr. Z.A. Bhutto, Minister of Industries being shown some of the researches carried out in the Pesticides Evaluation Section of the Central Laboratories in Karachi.

Mr. S. M. Yusuf, Secretary, Ministry of Industries (extreme right) having a discussion with Dr. Salimuzzaman Siddiqui, Chairman, P.C.S.I.R., during his visit to the Central Laboratories.

3. MICRO DETERMINATION OF CHLORINE IN ORGANIC COMPOUNDS: The procedure consists in decomposition of the compounds in a nickel capsule with sodium metal enclosed in a sealed glass tube at 250°C. The chloride formed is converted into hydrochloric acid through cation exchange resin. The acid is titrated with a standard alkali. The method is applicable to solids as well as liquids, and avoids the uncertainties and difficulties associated with titration and gravimetric procedures.

Publication: 'Micro Determination of Chlorine in Organic Compounds' by R. A. Shah, S. A. Jabbar and M. K. Bhatty, *Pak. J. Sci. Ind. Research* **5**, 162 (1962).

4. MICRO-ESTIMATION OF AJMALINE: A new turbidimetric method has been developed in this laboratory for the estimation of Ajmaline in the range of 4-60 microgrammes. The procedure has been successfully applied to a single spot obtained after chromatographic or electrophoretic separation of Ajmaline from Rauwolfia alkaloids. The paper has been sent for publication.

Project Associates: R. A. Shah and Nargis Fatima.

5. IDENTIFICATION OF VARIOUS CONSTITUENTS OF AJMALEXINE AND INVESTIGATION OF TWO UNKNOWN CONSTITUENTS: The alkaloidal complex ajmalexine was isolated from the fresh roots of *Rauwolfia serpentina* by Siddiqui et al on the basis of its solubility in ethyl acetate. The complex forms a cream coloured powder consisting mainly of alkaloids of the Ajmaline group and weaker Rauwolfia bases with reserpine and rescinamine. Various constituents of Ajmalexine have been identified chromatographically. The two unknown constituents have been isolated for identification from a large number of spots obtained after electrophoresis of Ajmalexine.

Project Associates: R. A. Shah and Nargis Fatima.

6. REDUCTION OF BARYTE WITH SUI GAS USING DIFFERENT CATALYSTS: 92-95% reduction of Baryte has been achieved with Sui gas by using different catalysts. The barium sulphide thus produced will be used as a starting material for the manufacture of Blanc-fix, Barium chloride and other compounds of barium of analytical reagent grade. Further investigations in regard to the reduction of other alkaline earth sulphates by a similar process are in hand.

Project Associates: R. A. Shah and Irshad Ahmed,

7. Sodium Silicate: A new type of furnace for the melting of sodium silicate with a sloping hearth for continuous work (recuperative system) has been designed for pilot-scale production of sodium silicate of different types with different soda-silica ratios. Work on this project is still in progress.

Project Associates: R. A. Shah, M. Aslam and S. Tehzibul Hasan.

8. Decorative Facing "Stones": A new building material, which looks like coloured sandstone has been developed. This can be used in place of natural sandstone, which is widely used at present for decorative purposes, in the construction of buildings and monuments. The cost of the new synthetic stone developed by the Central Laboratories will be about one-fourth of the natural stone. It can be made into any shape desired by the architect and can be easily fixed to the walls by a relatively unskilled mason.

Project Associates: M. Aslam, R. A. Shah and S. Tehzibul Hasan.

9. A Modified Furnace for the Reduction of Antimony Oxide: A furnace has been designed for the reduction of Sb_2O_3 to Antimony metal. After a series of experiments, the batch composition has been worked out for getting maximum yield of the metal. A paper has been accepted for publication.

Project Associates: R. A. Shah and S.A. Hai.

10. Fibre Glass: A suitable furnace has been constructed for spinning glass fibres. Crucibles required for the purpose have been produced in the laboratory. The work will be conducted in two phases.

(*i*) To work out a suitable glass composition for drawing fibres.

(*ii*) To design equipment for the large scale production of glass fibres.

Project Associates: R. A. Shah and Sultan Ahmed.

11. Utilisation of Natural Products Containing Saponins: (*a*) Saponins for the Production of Cellular Concrete: Saponins from indigenous sources have been successfully used for the production of cellular concrete. The natural product (containing saponins) are digested with water to make a concentrated solution, a small amount of which is then added with a stabilizers to the required quantity of water in a high speed mixer.

Cement and other aggregates are finally added to obtain foamed concrete. Usually 0.04% of the Foaming agent by weight of cement is required.

By varying the quantity of water, it is possible to control the density of the cellular concrete. The compressive strength and the thermal conductivity values for the foamed concrete, obtained by this process, is considerably superior to that of other foaming agents presently available in the country.

Patent application No. 878/62 dated 26.9.62.

Project Associates: Mohammad Jehangir and M. Arshad A. Beg.

(*b*) SAPONINS AS BUFFERS: One of the important properties of saponins is their buffer action. A series of investigations has revealed that their effective range is 2.5 to 5 pH units with a Buffer capacity of 0.074, which is comparable with known buffers such as a mixture of sodium acetate and acetic acid. The Buffer capacity of mixtures of saponins with sodium acetate and with acetic acid has been found to be 0.1 and 0.08 respectively. In the former case the effective range is also extended to 7.0 pH units.

Project Associates: M. Arshad A. Beg, Mohammad Jehangir and Amin R. Shaikh.

12. DEPICKLING AGENT FOR THE LEATHER INDUSTRY: Various depickling agents are in use in the leather industry. Several combinations of buffer mixtures have been worked out and it has been observed that extracts of some locally available natural products can act as a suitable depickling agent. Various mixtures with the extract have also been experimented with. Pilot scale study is in hand.

Project Associates: M. Arshad A. Beg, Mohammad Jamil Khan and Mohammad Jehangir.

13. A FOAM FIRE-EXTINGUISHING COMPOSITION: Foams for fire fighting are usually obtained by mixing an aluminium salt with an alkaline carbonate and a stabilizer, and a composition has been developed using these indigenous materials. The results indicate that composition is superior to those being imported. Patent for the process has been applied for.

Project Associates: M. Arshad A. Beg and Mohammad Jehangir.

14. NICKEL SALT FOR ELECTROPLATING: A composition for the

preparation of nickel salt for nickel plating has been developed. Bright finishes have been obtained and buffing of the plated surfaces has been avoided to a great extent. Patent coverage is being obtained.

Project Associates: M. Arshad A. Beg and Mohammad Jehangir.

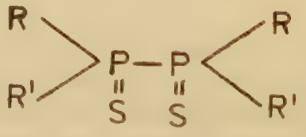
15. Infra-red Studies on some Organo-selenocyanates: The infra-red spectra of some organo-selenocyanates have been studied in detail to obtain information regarding the structure of these compounds. It apears that their structure is of the type R—N=C=Se and not R—Se—C≡N. The results are being prepared for publication.

Project Associates: M. Arshad A. Beg and S. Khaqan Hasan.

16. Studies on Phosphorus Compounds: (*a*) Acceptor Properties of Phosphorus: Phosphorus is known to be an electron donor, but its acceptor properties have not so far been studied. Four complexes of thiophosphoryl chloride and phenyl-thiophosphoryl chloride have been prepared in dry ether with ethylenediammine and $\alpha-\alpha'$ dipyridyl. The I.R. and U.V. spectra have been analysed.

Project Associates: M. Arshad A. Beg and Mohammad Siddique Siddiqui.

(*b*) Preparation of Phosphines of the Type RR'R"P: The available methods are lengthy and usually very low yields are obtained. An easier method has been developed, consisting in the preparation of compounds containing P—P bond. These compounds can be easily prepared by reacting a substituted thiophosphoryl chloride with a Grignard reagent, when a compound like



is obtained. This on reaction with an alkyl or perfluoroalkyl iodide gives the sulphide of the desired phosphine. The sulphide on reduction with lithium aluminium hydride gives the phosphine.

The method is being tried out for a larger number of compounds containing the P—P bond.

Project Associates: M. Arshad A. Beg and M. A. Hashmi.

17. MANUFACTURE OF SODIUM META-SILICATE AS AN INDUSTRIAL DETERGENT: Water glass with the $Na_2O:SiO_2$ ratio of 1:2 to 1:4 has a limited market as a filler in Soap Industry. Since some of the large soap manufacturers have set up their own units for the production of water glass, the industry has been faced with the serious problem of finding a outlet for their products. The problem of extending the utilisation of water glass was referred by several manufacturers and the project of converting water glass into sodium metasilicate, which finds a considerable use as an industrial detergent, was taken up at these laboratories. The preparation of meta-silicate from water glass has been successful on a laboratory scale and the product conforms to relevant ASTM specification. Pilot plant studies, however, have to be carried out for studying the economics of this process.

Project Associates: S. J. Quadir and M. M. Omer.

18. PHASE STUDY OF $ZnO-SiO_2-Mn$; $CaO-WO_3-Pb$; $MgO-AS_2O_3-Mn$ AND THEIR USE IN NEON SIGNS COATINGS AND FLUORESCENT TUBES: These systems are being studied with a view to develop fluorescent pigments, which fetch a high price in world market. It has been found that these systems produce green, blue and red fluorescence respectively under carefully controlled conditions. These three colours are additive primaries and other colours can be manipulated by blending them in suitable proportions.

Project Associates: S. J. Quadir and S. H. Rizvi.

Micro - Analytical Laboratory

The Micro-Analytical Laboratory undertakes to determine C,H,N (Dumas), sulphur, iodine, bromine, chlorine, methoxyl group estimation, molecular weight and nitrogen by Kjeldahl method. During the years under review, a number of analyses were carried out for various divisions of the Central

Laboratories and the West and North Regional Laboratories. Some details of the total number of analyses performed are given below:-

C & H	202
Nitrogen	246
Chlorine	50
Sulphur	5
Zinc	1
Total	504

The determination of oxygen has also been started and the worker is under training for the last six months. The standard of accuracy and reliability has been greatly improved.

GENERAL ORGANIC CHEMISTRY

(1) Study of Acylarylnitrosamine Reaction and Preparation of Unsymmetrical Biaryls: (*a*) Two methods described in literature for the preparation of nitrosoacylarylamines (the key intermediates for the preparation of Unsymmetrical biaryls) suffer from certain drawbacks, and even fail in certain cases (*Organic Reactions*, Vol. II, 1944, page 244; Davies, Hey, Rees and Saunders, *J. Chem. Soc.*, 1959, 2317). It was found that nitrosylsulphuric acid, which could be prepared more easily and in a pure state, could smoothly nitrosate the acyl derivatives of aromatic amines at 0-5° in the presence of acetic anhydride, alkali salts of weak acids and a little phosphoric anhydride. The otherwise unstable nitroso derivatives were isolated at low temperatures and those, which separated as solids, were analysed. On heating with a large excess of benzene, these nitrosoacetylarylamines decomposed, evolving nitrogen, and the resulting free aryl radicals attacked the surrounding solvent producing the otherwise inaccessible unsymmetrical biaryls. The following nitrosoacylarylamines and their corresponding biaryls (melting point and yield given in brackets in both the cases) were prepared.

(*i*) NITROSOACETANILIDES:

Unsubstituted (m. 51°d; 91%); 2-methoxy (yellow oil); 4-methoxy (m 40-41°d); 4-ethoxy (m. 65°d); 2-nitro (yellow oil); 3-nitro (yellow oil); 4-nitro (m. 75°d); 2-methoxy-4-nitro (m 82-3°d); 2-methoxy-5-nitro (yellow oil); 4-methoxy-2-nitro (yellow oil); 4-methoxy-3-nitro (m. 83.5°d); 4-ethoxy-2-nitro (m. 45° decomposes at 52°); 4-ethoxy-3-nitro (m. 80°d).

5-(N-nitroso)-acetamidoisoquinoline (yellow unstable oil); 6-methoxy-5-(N-nitroso)-acetamidoquinoline (yellow unstable oil).

(*ii*) CORRESPONDING DIPHENYLS:

Unsubstituted (m. 71°; 89%); 2-methoxy (oil; 31%); 4-methoxy (m. 86-87°; 60%); 4-ethoxy (m. 73-74°; 70%); 2-nitro (oil; 65%); 3-nitro (m. 59°; 71%); 4-nitro (m. 113°; 60%); 2-methoxy-4-nitro (m. 66-67°; 30%); 2-methoxy-5-nitro (m. 93-94°; 55%); 4-methoxy-2-nitro (m. 72-73°; 33%); 4-methoxy-3-nitro (m. 93-94°; 64%); 4-ethoxy-2-nitro (m. 64-65°; 32%); 4-ethoxy-3-nitro (93-94°; 75%).

5-Phenylisoquinoline (colourless oil; picrate m. 185-186°; 29%); 6-methoxy-5-phenylquinoline (m. 145-146°; 21%).

Project Associates: Yusuf Ahmad and M. Ikram Qureshi.

(b) An interesting observation had been made by Meldda *et al* (*J. Chem. Soc.*, 1898-1913), and also by the later workers that a nitro group is eliminated during diazotisation of di (or poly) nitroanilines, if this nitro group is in ortho or para position with respect to the diazonium group and is further suitably activated [i.e. by the presence of another nitro group either in ortho or para position to the first nitro group. This activation can also be achieved by some other substituents (see for example Dey, Maller & Pai, *J. Sci. Industrial Research* (*India*), V 10B, 140-144 (1951)]. This elimination of the nitro group under the above conditions has been explained on the basis that the diazonium group is an extremely strong electron attracting group and, therefore, makes the nitro group in ortho or para position to it, prone to nucleophilic attack, but elimination of this nitro group takes place if it is further activated by presence of other electron attracting groups in suitable positions. This observation clearly indicates that the mechanism of decomposition in these cases is ionic in nature.

Nitrosoacetylarylamines are said to be isomeric with the corresponding aryldiazonium acetate (*Organic Reaction*, Vol. II, 1944, page 244). But mechanism of their decomposition is different. On warming in a non-polar solvent they lose nitrogen, whereby a free aryl radical is generated, which attacks the surrounding solvent. This fact is borne out by the present study in which acetyl derivatives of 2, 3-dinitro; 3,4-dinitro; 2-methoxy; 4-5 dinitro; 4-methoxy-2, 3-dinitro; 4-methoxy-2, 5-dinitro; 4-ethoxy-2, 3-dinitro; 4-ethoxy-2, 5-dinitroanilines (all these compounds fulfill the conditions laid down in the first paragraph) were successfully nitrosated by the method described in sub section (*a*). The nitroso derivatives were isolated, and these on warming in benzene decomposed evolving nitrogen. The residue after removal of the solvent in each case gave the corresponding diphenyl in which both the nitro groups were intact. These unsymmetrical diphenyls were obtained in good yield.

Project Associates: Yusuf Ahmad and M. Ikram Qureshi.

(2) Aporphine Alkaloids: In the classical method for the synthesis of aporphine alkaloids, 1-benzylisoquinoline derivative bearing an ortho nitro group on the benzyl moiety is obtained. Reduction of the nitro group and final cyclisation through the Pschorr reaction would give the appropriate aporphine. Even this method failed in some cases (*J. Chem.*

Soc., 1954, 2246-2256). Attempts to build up aporphine structures through routes other than this classical method have met little success. (*J. Chem. Soc.*, 1929, 1666-1676; *Helv. Chem. Acta.* 1048, **31**, 1119-1132). Formation of aporphines by first synthesising 8-phenylisoquinolines and then putting a one carbon bridge between 1 position of the isoquinoline part and the 2- position of the phenyl part of this molecule do not seem to have been attempted. To achieve it 8-phenylisoquinoline, 5-chloro-8-phenylisoquinoline and 7-methoxy-8-phenylisoquinoline have been successfully synthesised in these laboratories. Further work to put one carbon bridge has been undertaken.

Project Associate: Yusuf Ahmad.

(3) Study of Nitrene Intermediates: Contrary to the suggestion of Smith & Suschitzky (*Tetrahedron*, **16**, 80-84,1961) that a free >NH is necessary for any cyclisation to give heterocyclic compounds of the general type II. from

I II

N-substituted-O-nitroaniline derivatives (I) by heating with ferrous oxalate, we have found and confirmed our previous findings (Abramovitch, Y. Ahmad and Newman, *Tetrahedron Letters*, No: 21, pp 752-757, 1961) that this reaction involves nitrene (electron deficient nitrogen) intermediates. Ferrous oxalate on heating decomposes to an active form of iron, which deoxygenates the nitrogen of the nitro group, generating a biradical. N-(O-nitrophenyl) Carbazole and N-(O-nitrophenyl) piperidine, both of which possess no free NH, have been successfully cyclised to the corresponding cyclised heterocycles. A number of other O-nitroanilines, in which both the hydrogens of the amino group are substituted (or this nitrogen forms a part of a ring system) have been prepared and the study of nitrene intermediates is being further extended.

Project Associates: Yusuf Ahmad and Ziauddin.

BIOCHEMICAL RESEARCH

1. Fish Flour: The shark meat flour prepared in these laboratories had the biological value of only 61 upto 1960. Modifications were, therefore, undertaken to improve the product, and now its protein utilization has reached the happy limit of 80. This is an improvement upon Patent No. 110391.

Project Associates: S. Mahdihassan and Ashfaq Husain.

2. Guar Seed: This was improved further since the last report. Samples were sent to the Institute of Human Nutrition, London, where Dr. Miller found its biological value to be 41. The amino acid make-up is revealed in the following paper.

Publication: 'Salvaged Proteins For Pakistan' by S. Mahdihassan IPFC (Current Affairs) Btn. of FAO., Bangkok 35, 12-14 (1962).

3. Anti-anemic Preparations of Trace Elements: These investigations cover the preparation and testing of complexes of several important elements namely, iron, vanadium, copper, molybdenum, manganese, nickel and cobalt. The details have been published in a series of papers.

Publications: (*i*) 'Future Studies on Iron-Carbohydrate Complexes' by S. A. H. Zaidi, S. Ashfaq Husain and S. Mahdihassan. *Arzneimittel-Forsch,* 12, 52-55 (1962).

(*ii*) 'Iron Complexes with Lactose Maltose and Malt' by S.A.H. Zaidi, S. Ashfaq Husain and S. Mahdihassan. *Pak. J. Sci. Ind. Research* **5**, 43 (1962).

(*iii*) 'Vandanium Carbohydrate Complexes' by R.B. Qadri and S. Mahdihassan. *Pak. J. Sci. Ind. Research* **5**, 44-45 (1962).

(*iv*) 'Copper Carbohydrate Complexes' by R.B. Qadri and S. Mahdihassan. *Pak. J. Sci. Ind. Research* **5**, 46-47 (1962).

(*v*) 'Molybdenum Carbohydrate Complexes' by R. B. Qadri and S. Mahdihassan. *Pak. J. Sci. Ind. Research* **5**, 187-189 (1962).

(*vi*) 'Manganese Carbohydrate Complexes' by R.B. Qadri and S. Mahdihassan, *Pak. J. Sci. Ind. Research* **5**, 189-190 (1962).

(*vii*) 'Nickel Carbohydrate Complexes' by S. A. Bari and S. Mahdihassan, *Pak. J. Sci. Ind. Research* **5**, 191-192 (1962).

(*viii*) 'Cobalt Carbohydrate Complexes' by S. A. H. Zaidi, S. Ashfaq Husain and S. Mahdihassan, *Pak. J. Sci. Ind. Research* **5**, 193-195 (1962).

4. REVITAMINIZATION OF POLISHED RICE: As a result of systematic laboratory studies, revitaminized rice grain has successfully been prepared. Formerly the rice grain used to be brittle, and the cooked rice was a pasty material. As against this the revitaminized rice now remains whole-grain rice on cooking. As yet the process is not cheap enough and efforts are being made to curtail some of the stages of production.

Project Associates: S. Siddiqui and Abdul Haq.

5. SIND LAC: The forest department in Sind has experimented on increasing the yield of the lac. The present situation of lac production in Sind was surveyed and it came to light that there are many problems of vital importance, which call for their rapid solution. Some of these problems as well as specific researches on the lac insect are described in a series of publications.

Publications: (*i*) 'A Survey of Lac Production particularly in Sind' by S. Mahdihassan, *Pak. J. Forestry* **23**, 78-79 (1961). (*ii*) 'Waxes of Lac Insect and their Glands' by S. Mahdihassan, *Zeit. ang. Entom.* **48**, 433-444 (1961). (*iii*) 'Lakshadia Nagoliensis as compared with L. communis' by S. Mahdihassan, *Zool. Anzg.* **167**, 115-126 (1961). (*iv*) 'Consideration on isolating Bacteria associated with Cyclostoma' by S. Mahdihassan, *Zool. Anzg.* **167**, 170-177 (1961).

6. RENNET: Rennet is imported from foreign countries for the local cheese industry. Its biological source is very doubtful. Hence considering the tradition of the country, it is preferable to obtain rennet from the stomach of local goats and sheep. The product is still not cheap enough and further work is being continued to make it a commercial success.

Publications: (*i*) 'Preparation of Commercial Rennet' by R.B. Qadri, A. H. Burney and S. Mahdihassan, *Indian J. Pharm.* **23**, 78-79 (1961). (*ii*) 'A Revised Method of preparing Rennet' by R.B. Qadri, M.A. Ansari and S. Mahdihassan, *Pak. J. Sci. Ind. Research* **5**, 196-197 (1962).

7. HISTORY OF ISLAMIC CHEMISTRY: All over the world there is a tendency to study the history of sciences. In view of this fact, extensive studies were carried out and the following papers published during the years under review.

Publications: (i) 'Alchemy in the Light of its Names in Arabic, Sanskrit and Greek' by S. Mahdihassan, *Janus*, **49**, 79-100 (1961). (*ii*) 'Alchemy, Its three Important Terms and Their Significance' by S. Mahdihassan, *Med. J. Australia*, 55-Aug 227-228 (1961) (*iii*) 'Elixir, Its Significance and Its Origin' by S. Mahdihassan, *J. Asiatic Soc. Pakistan*, Dacca, **6**, 39-53 (1961). (*iv*) Ouroborous As the Earliest Symbol of Greek Alchemy' by S. Mahdihassan, *Iqbal*, Lahore, **9**, 1-21 (1961). (*v*) 'Der Chino-arabische Unsprung des Words Chemickalie' by S. Mahdihassan, *Pharm. Ind.* **23**, 515-518 (1961). (*vi*) 'Bazar Medicines of Karachi: Fresh Herbs' by S. Asad Maqsood Ali, S. Bazar Rizvi, S. Zafarul Hasan and S. Mahdihassan, *Medicus*, **21**, 264-274 (1961). (*vii*) 'Drugs of Pavement Herbalists' by S. Asad Maqsood Ali, Mohammad Tasnif, S. Zafarul Hasan and S. Mahdihassan, *Medicus*, **23**, 24-34 (1961). (*viii*) 'Drugs of animal origin' by S. Asad Maqsood Ali and S. Mahdihassan, *Medicus*, **23**, 72-76 (1961). (*ix*) 'Inorganic drugs' by S. Asad Maqsood Ali and S. Mahdihassan, *Medicus*, **23**, 125-131 (1961.) (*x*) 'Vegetable Drugs in Stock of Herbalists' by S. Asad Maqsood Ali and S. Mahdihassan, *Medicus*, **23**, 243-252 (1962). (*xi*) 'Calcined metals or Kustas' by Hakim S. Jamshed Bakht and S. Mahdihassan, *Medicus*, **24**, 117-122 (1962). (*xii*) 'Pavement Pharmacy in Karachi' by Sanul Haque, S. Asad Maqsood Ali, Ashfaq Hussain and S. Mahdihassan, *Medicus*, **24**, 220-223 (1962). (*xiii*) 'Essences a Class of Alchemical Preparations', by Hakim S. Jamshed Bakht and S. Mahdihassan, *Medicus*, **24**, 257-264 (1962). (*xiv*) 'Uber einige symbols der Alchemie' by S. Mahdihassan, *Pharm. Ind.* **24**, 41-45 (1962). (*xv*) 'Symbolism in Alchemy, Islamic and others' by S. Mahdihassan, *Islamic Culture*, Hyderabad (Dn.), **1**, 20-34 (1962). (*xvi*) 'Alchemy in the Light of Jung's Psychology & of Dualism' by S. Mahdihassan, *Pakistan Philos. J.* **5**, 95-103 (1962). (*xvii*) (*a*) 'Was ist eigentlich Alchemie' by S. Mahdihassan, *Deutsch Apoth Zeitz.* **102**, 512 (1962). (*b*) 'what is Alchemy' by S. Mahdihassan, *Sci. Chronicle*, **1**, 18-19 (1962). (*xviii*) 'A Rational Interpretation of the Four Cormic Elements Operating in Alchemy' by S. Mahdihassan, *Inst. Hist. Medicine* (Hamdard) Delhi, 184-210 (1962). (*xix*) 'Kimiya & Iksir' by S. Mahdihassan, *Lab. Bkn.*, (May & Baker) **5**,38-41 (1962). (*xx*) 'Philosopher's Stone and its Original Conception' by S. Mahdihassan, *J. Asiatic. Soc. Pakistan*, Dacca, **7**, 263-267 (1962). (*xxi*) 'Kekule's Dream of the Ourobous and the Significance of this Symbol' by S. Mahdihassan, *Scientia*, **55**, 187-195 (1961). (*xxii*) 'Pakistan's Pharmaceutical Industry-Present and Future' by S. Mahdihassan, *Trade and Industry* (Kar.) 512-513 (1962.)

8. Bacteriological Examination of Drinking Water from Different Localities of Karachi and Isolation of Enteric Pathogens: As a prerequisite to the development of a domestic water filter it was considered necessary to carry out a thorough bacteriological investigation of drinking water from various localities of Karachi so as to find out the extent of pollution in it. Among the total samples so far collected about 60% showed Coli-positive test and thereby giving the evidence of contamination. Besides *Escherichia coli*, other pathogens were found belonging to Genus Salmonella, Shigella, Staphylococci and Streptococci. In order to make it more comprehensive the work has been extended to include almost all the localities left out in our survey in Karachi.

Project Associates: Zahir Ahmed, Iqbal Ahmed Poshni and Mahmood Ahmad Siddiqui.

9. Development of Domestic Water Filter from Indigenous Raw Materials: On the basis of the results obtained in preliminary experiments noted elsewhere in this report, further work has been carried out for the development of a domestic water filter, which could render Karachi drinking water bacteria free. Various clays are being tested for the porosity of the candles used in the filter. The whole unit can be fitted in the water taps, while for popularizing such filters in the rural areas a device is being made to fit the filter candle in small water container.

Project Associates: Zahir Ahmed, M. Arshad A. Beg and Mohammad Jehangir.

10. Isolation of Pathogenic Microorganisms from Locust and their Toxicological Effects on Laboratory Animals: From the commonly invading species of Locust, *Schistocerca gregaria*, a number of pathogenic microorganisms namely Shigella, Staphylococci, Proteus and Candida were isolated. Considering the mass consumption of locusts as food in rural and urban areas of Pakistan, their pathogenicity and toxigenicity were tested on laboratory mice. Detailed investigations are in progress and the results obtained will shortly be published.

Project Associates: Zahir Ahmed and Mahmood Ahmad Siddiqui.

11. Studies on Trematode Metabolism: In recent years, a number of workers in the field of parasitology have directed their attention to the studies on physiology of parasites, because a parasite synthesizes new protoplasm, reproduces it in the host and exerts physiological and biochemical effects. Most of the parasites adversely affect the host, and some of

this host reaction appears as the sign, symptoms and pathology ordinarily associated with the infection. But the specific host parasite interactions, the detailed causes and effects in these infections are still unknown.

Massive infection with *Paramphistomum cervi*, a conical fluke in our cattle and ruminants, has led us to undertake the problem of host parasite relationship for this case. The investigation is planned to provide information on metabolism of the parasite. To start with, chemical composition especially its contents of inorganic substances, glycogen and sugar is being tested.

Project Associates: Zahir Ahmed, M. Arshad A. Beg and Maryam Saleh.

12. Studies on *Abrus precatorius* Linn: The toxic fraction "Abrulin" isolated from the scarlet variety of Jequirity seeds, was studied with regard to its biochemical properties. The toxin is quite stable upto 80°C and is not appreciably digested by trypsin and pepsin. Abrulin causes haemagglutination and is toxic in an amount of 50 mg/kg when given orally. The toxicity of abrulin is enhanced through the addition of proteins.

Publications: (*i*) 'Studies on *Abrus precatorius* Linn. Part I—Isolation and Toxic Properties of "Abrulin" a Protein Fraction from the Seeds' by A. H. Khan, Mumtaz A. Hashmi and M. Ikhlas Khan, *Pakistan J. Sci. Ind. Research*, **4**, 53 (1961).

(*ii*) 'Studies on *Abrus precatorius* Linn. Part II—Biochemical and Pharmacological Studies on Abrulin' by M. Ikhlas Khan and A. H. Khan. *Pakistan J. Sci. Ind. Research*, **5**, 216 (1962).

13, Stability of Vitamin 'A' in Ghee and Vitaminised Vanaspati: Stability of vitamin 'A' in ghee and vanaspati under varying conditions of cooking has been studied. It has been observed that heat treatment under varying conditions brings about almost the same loss of Vitamin 'A' in ghee as in vanaspati. Frying causes more than 70% loss of vitamin 'A' after 15 minutes both in ghee and vanaspati. Heating at 100°C in an oven causes practically no loss of vitamin 'A' in 15 minutes. Even after one hour, only 18% of the vitamin is lost. This shows that at 100°C the loss is comparatively less than in other types of heat treatments e.g., frying and boiling in water. It has, therefore, been suggested to consume butter or vitaminised fat e.g., margarine, in the raw state and employ oil and fats with little or no vitamins for cooking purposes. A paper has been sent for publication.

Project Associates: A. H. Khan, S. M. Ali and A. Haque.

PESTICIDE RESEARCH

Every year Pakistan imports pesticides worth four crores of rupees, which solve barely ten per cent of the pest problems that confront us.

Research on pesticides has been in progress in the Central Laboratories for quite some years and several pesticides based on indigenous materials like pyrethrum, gasoline from Daudkhel Fertilizer factory, and copper rosinate are under experimentation.

1. INSECTICIDES: (a) MAKROLIN AS LARVICIDE: Further work carried out during the years under review on a modified scale suggested by the World Health Organisation of the United Nations to test the larvicidal action of Makrolin and other petroleum products has borne the following results:

For solutions prepared in acetone, it was found that 13 P.P.M. of Makrolin and 15 P.P.M of D.D.T. were required to get LC 95. At present work on Chlorinated Petrol (Foreign and Indigenous) is under progress.

Project Associates: Shahid H. Ashraf, Miss Dilshad Asmatullah, S.M. Murtuza, Entomology Section, and S.A. Qureshi, Chemical Engg. Section.

(b) MAKROLIN AS CONTACT INSECTICIDE: The method used has already been described in the previous report and it was found that LD_{50} of Makrolin and D.D.T. against cockroaches was 38 ug cockroach and 183 ug cockroach respectively, i.e. Makrolin is approximately five times better than D.D.T. against cockroaches.

By comparing the toxicity results of Makrolin with Heptachlor, Aldrin, Chlordane, and D.D.T., it was found that Makrolin promises to be a useful insecticide with pronounced specificity against some of the insects.

Project Associates: Shahid H. Ashraf, Miss Dilshad Asmatullah, S.M. Murtuza, Entomology Section, and S.A. Qureshi, Chemical Engg. Section.

(c) RESIDUAL EFFECT OF MAKROLIN: For testing the residual effect of Makrolin in comparison with Aldrin, Dieldrin, Endrin, Heptachlor, Lindane, Methoxychlor and Pyrethrum, *Tribolium castaneum* flour beetles were

used. The residue treated filter was kept at 75 ± 5 per cent relative humidity and 98 ± 2°F temperature.

The experiments were carried out for 93 days and it was observed that Makrolin gave a short residual effect like Pyrethrum and Methoxychlor.

Project Associates: S. H. Ashrafi and Aijaz Ali.

(*d*) Makrolin as Acaricide: Mites are not only a very dangerous parasite of vegetables, deciduous fruits and many other crops of agricultural and industrial value, but also cause many diseases in man, poultry and other domestic animals. Some mites are liable to attack man and their bites may cause a violent itching and even febrile symptoms in heavy attacks. They also transmit Rickettsiae (typhus fever), spirochaetes (relapsing fever), and viruses (Far East encephatitis).

In Pakistan a considerable quantity of vegetable and cotton plant is damaged every year by the mites. Therefore, a general survey of mites fauna found in Pakistan has been undertaken and is intended to study methods for controlling them by using different chemicals and biological agents. It is proposed to test the miticidal properties of Makerol—a coal distillation fraction obtained from Makerwal coal, and compare it with some imported Acaricides.

Project Associates: S. H. Ashrafi and M. Anwarullah.

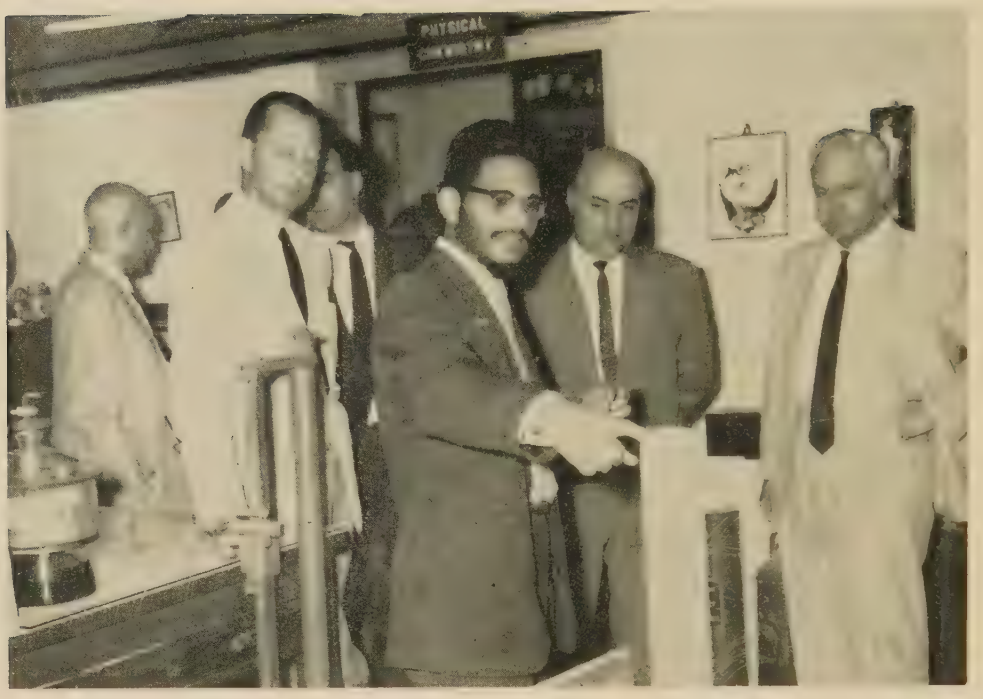
(*e*) Estimation and Isolation of Pyrethrum: Principal among the insecticides from plant sources in Pakistan is Pyrethrum, derived from *Chrysanthemum cinerafolium* Trev. In January, 1961, preliminary investigations were undertaken on the estimation, isolation and biological evaluation of a series of samples of pyrethrum flowers received from the Medicinal Plant Research Institute, Abbottabad, where the cultivation is being done on an experimental scale.

The preliminary results were encouraging and promised that if proper attention is given to the cultivation, the content may be increased up to the level of other countries. The total pyrethrin content in the indigenous flowers is estimated at 0.7—1.2%; whereas in the flower heads of Kenya and Japan it is about 1.8—2%.

The 12% concentrate of pyrethrum was prepared by following Indian Patent No. 35338 (Siddiqui, et al 1948), but later a new method was

Mr. Hashim Mohd. Ali, Chief Mechanical Engineer (extreme right) taking the Secretary, Ministry of Industries, Mr. S. M. Yusuf round the Workshop.

Dr. S. Mahdihassan, Head of Biochemical Division (extreme right) showing the Indonesian visitors some of new processes developed in the Division.



Dr. M. M. Qurashi, Head of Physics Division (centre) showing the working of an experiment on Physics of liquids to the Director of Swiss Foundation, Mr. Hrity Real in the Physics Division.

Prof. Hoessle, Head of Fuel Research Division explaining his work on the the partial desulphurisation and upgrading of coal to some foreign dignitories.

developed in which sesame oil was used during extraction. By following this method a 14% concentrate of Pyrethrum was obtained under laboratory conditions. The work is still in progress.

Project Associates: S. H. Ashrafi, Mohammad Tasnif and Raees Ahmad Khan of PCSIR, and M. B. Zaman, Medicinal Plant Research Officer, Forest Research Institute, Abbottabad.

2. PHYTOTOXICITY RESEARCH: Phytotoxicity measurements on the chlorinated insecticides, which have been developed in the Central Laboratories from indigenous materials were undertaken before using them in field. It is not desired to control the pest at the cost of destroying the crops and other vegetation through their high phytotoxicity. For these tests a small experimental farm has been developed, where cereal, vegetable and other crops are being cultivated, so that experiments could be done in natural conditions. The insecticides, *viz.* Makrolin, chlorinated petrol and chlorinated motor spirits were being tested in various fractions, both in the form of emulsions and in dilutions with suitable solvents. It was found that upto 6% solution (maximum concentration) of Makrolin and a series of chlorinated petrols gave different toxic effects on different plants, whereas 2.5% solution of Makrolin and chlorinated petrol did not show any phytotoxic effect. Other workers have reported low toxic effect of different chlorinated insecticides on different plants. In laboratory experiments it was found that 3% solution in acetone of Heptachlor, BHC, DDT, Chlordane, Dieldrin, Makrolin and Chlorinated Petrol gave low phytotoxicity against maize, Cucurbitaceous plants, brinjals, tomatoes, beans, beet roots, raddish sugar cane, cotton and cabbages. These experiments were continued up to the time of flowering and fruition period. According to these observations, indigenous insecticides can safely be used on the level of above mentioned foreign insecticides. The work on different fractions of chlorinated petrol and Makrolin is still in progress.

Project Associates: S. H. Ashrafi, Mohammad Tasnif and Raees Ahmad Khan.

3. (a) DUST CARRIERS: Insects are causing incalculable damages to our agriculture, forestry, live-stock and some time to the human being. We are spending our national income by importing foreign insecticides worth millions of rupees. One of the necessities in Pakistan is to find out a cheap and effective insecticide, which should be based on indigenous materials to be used as dust carriers. The indigenous inert dusts, multani mitti, gypsum and french chalk, can be used as dust diluents and insecticide carriers,

These dusts are economically very cheap and are suitable for all kinds of technical grades. Various types of technical grades have been developed in the Central Laboratories, and are under testing on different vegetable and cereal crops.

Project Associates: S. H. Ashrafi, Mohammad Tasnif and Raees Ahmad Khan.

(b) Mosquito Repellent Creams: Mosquito repellent creams have become a part of daily use all over the world, and a number of mosquito repellents are imported in our country. The purpose of the present project is to develop repellent creams from indigenous raw materials. The products prepared so far were found very effective, and at the same time attempts are being made to keep them in consonance with the taste of the people. It is not harmful to the skin and has a pleasant smell in addition.

Project Associates: S. H. Ashrafi, Mohammad Tasnif and Raees Ahmad Khan.

4. Fungicidal Activity of Makrolin and Copper Rosinate as compared with Copper Naphthenate and Colloidal Copper, against the Spore Germination of *Aspergillus niger*: The fungicidal activity of indigenous materials, Makrolin and Copper rosinate have been compared with other imported fungicides, Colloidal copper and Copper naphthenate, by testing them against the spore germination of *Aspergillus niger*.

It was found that Makrolin inhibited the germination of *Aspergillus* spores, in nutrient broth, at 0.3%, Copper rosinate at 4.75%, upto one week. After six weeks of the inhibiting concentrations of the different fungicides were; Makrolin 0.4%; Copper rosinate 8%; Colloidal copper 3.25% and Copper naphthenate again at 8%. In case of nutrient agar, the inhibiting concentrations for spore germination were Makrolin 3%, Copper rosinate 9%, Colloidal copper 6% and Copper naphthenate 9%.

Makrolin promises to be a good fungicide as compared with Copper rosinate, Collidal copper or Copper naphthenate.

Project Associates: S. H. Ashrafi, Mohammad Yusuf and Abdul Aziz.

5. (a) Microbiology Research: Pakistan with other Asian and African countries is facing the insidious problem of damages caused by

the desert locust. In continuation of our work on the pathogenic microorganisms of desert locust as a means of biological control, we have this year found out more organisms pathogenic to desert locust. The organisms isolated from diseased locusts include *Pseudomonas aeroginosa* and different species of fungi belonging to the genera *Aspergillus* and *Helminthosporium*. Fungi isolated from diseased locusts did not show pathogenicity, when the locusts were fed on infected food.

The work on pathogenecity of *Pseudomonas aeroginosa* against locusts has been completed. It has been definitely established that this organism is extremely harmful to locusts in very low doses through feeding, and as well as on spraying over them. The bacteria have also been tested against mammals *viz.* guniea pig, rabbit, white rats etc. and experiments on crops and vegetation are in progress.

Besides the above mentioned work, we are collaborating with the Department of Fisheries in testing their export products (Prawns etc.) for pathogenic bacteria of the Salmonella species.

Project Associates: Shahid H. Ashrafi, Riazul I. Zuberi and Sayeda Hafiz.

(b) Anatomy and Histology of the Digestive System of *Schistocerca gregaria:* Desert locust is of great economic importance. They were bred in the laboratory for many generations to study the biology. Complete morphology and histology of the digestive system of the locust has been studied and soon the findings will be published. Work on the morphology and histology of other systems is in progress.

Project Associates: S.H. Ashrafi and Saleem Akhtar.

6. Toxicity of different Insecticides against Mosquito Larvae: A comparative study of the following insecticides against mosquito larva is in progress.

1. Chlorinated petrol.
2. Lindane.
3. Heptachlor.
4. Endrin.
5. Toxaphene.
6. Dieldrin.
7. Methoxychlor.
8. Strobane.

Their effects are studied on the 4th instar larvae of *Ades aegypti*. Six of the above insecticides have been tested. Work on Methoxychlor and Strobane is in progress.

Project Associates: Shahid H. Ashrafi and Saleem Akhtar.

7. REARING OF PESTS: For some time past we have been trying to standardise the rearing of house-flies, cockroaches, mosquitoes, bed-bugs, flour-beetles and termites, and this problem has been solved to a very great extent by the construction of standard sized cages for breeding mosquitoes, house-flies, cockroaches etc. In our insectary, efforts are being made to rear termites, and for this purpose a new kind of termite box has been constructed in our workshop as it would help a lot in solving this problem. It is still under research whether the termite-box would be useful or not for rearing them.

Project Associates: Shahid H. Ashrafi and M. Wahajuddin Roomi.

INDIGENOUS MEDICINAL PLANTS INCLUDING RAUWOLFIA

1. CRESSA CRETICA: The plant Cressa cretica is reported to have antitubercular and antiseptic properties. From the petroleum ether soluble portion of the whole plant, an interesting crystalline substance, sparingly soluble in the common organic solvents has been obtained. It has a low melting point, 78-80°C, and is neutral in character.

The Infra-red spectrum in 'Nujol' gave peaks at 3500 cm^{-1} (indicating hydroxyl) and at 1750 cm^{-1} (indicating ester). Further work is in progress.

Project Associates: A. M. Ahsan and S. Mahmood.

2. CASSIA ABSUS: The work on the seed of *Cassia absus* Linn, which is used in indigenous medicine for the treatment of eye ailments, has mainly been concerned with the alkaloidal part. In the course of work on Chaksine in these Laboratories, a non-nitrogenous crystalline material, m.p. 292-293°C, has been obtained from the alcoholic hydrochloric acid extract of the seeds. It has an empirical formula $C_{35}H_{60}O_6$, $[\alpha]_D^{31}$—47.6.°

Its infra-red spectrum showed the presence of the hydroxyl group. This was confirmed by the preparation of the acetyl derivative m.p. 166-168°C.

Project Associates: A.M. Ahsan, G. Hahn and A. Wadood Qureshi.

3. JASMINIUM GRANDIFLORA: The flowers of *Jasminium grandiflora* (Chambeli) are reported to have contraceptive properties. They have been extracted with alcohol and the oil sent for Pharmacological testing.

Further work will proceed as soon as the report is available.

Project Associates: G. Hahn and A. Wadood Qureshi.

4. CONSTITUENTS OF CEDRUS DEODARA (DEAAR WOOD)—PART-I. ISOLATION OF DEWARENE AND DEWAROL: 'Deaar' wood is grown extensively

in the northern part of Pakistan and India. It is a soft wood with a characteristic sweet odour and is extensively used for furniture making in Pakistan. Some Indian workers have reported isolation of ∝-Himachalene and β-Himachalene from Himalayan Deodar. In the present work the wood chips, which are usually wasted by burning, were investigated with a view to obtaining useful chemicals out of them.

The alcoholic extract on steam distillation gave an oil as the steam distillate. This oil on repeated fractionations *in vacuo* gave two pure products, now designated as *Dewarene* and *Dewarol.*

Dewarene, b.p. 108°C/0.5 mm, η_D^{26}, 1.5105; d_4^{30} 0.982; $\propto_D^{22}$ +120° (liquid phase); U.V. max. 214,243 m (7,800; 625 in cyclohexane); is an unsaturated terpenic hydrocarbon $C_{15}H_{24}$ with two double bonds in the molecule. It absorbs bromine rapidly giving a dibromo derivative, which absorbs three moles of hydrogen, U.V. max 202, 240, 270 m (ε 32,500; 9,600; 6,000 in ethanol) which in presence of alkali shifts to λ max 211.5, 264 mμ (ε 22,500; 6,900 in ethanol). *Dewarol*, b.p. 130°C/1 mm, η_D^{23} 1.5141, $\propto_D^{23}$ 82° (1% soln. in chloroform) U.V. max 223.5, 245 mμ (ε 5,200; 1,700) in alcohol, is an unsaturated terpenic alcohol.

Project Associates: M. Manzoor-i-Khuda and Abdus Salaque.

5. Studies on the Constitution of Isochaksine: Of the two alkaloids, *chaksine* and *isochaksine*, isolated from the seeds of *Cassia absus* Linn, *chaksine* has been subjected to comprehensive structural studies and to an extent also pharmacological examination, but isochaksine which occurs naturally and also obtained in various ways through the isomerisation of chaksine, has remained completely neglected. In a series of earlier communications on the constitution of chaksine from the Central Laboratories, evidence was provided for the first time for a guanidine structure for the base with a possible terpenic carbon skeleton. The latter hypothesis was, however, open to objection that the thermal degradation of chaksine iodide leading to the formation of *p*-isopropyl benzoic acid and phthalic acid on the basis of which the terpenic skeleton was postulated could not be depended upon, as it was carried out at high temperatures. It was, therefore, considered of interest to carry out structural studies in isochaksine. Such a study had acquired added interest due to the fact that pharmacological studies carried out in the Central Laboratories showed it to be strongly hypotensive and much less toxic than chaksine. As a result of these studies it was possible to isolate *p*-isopropyl benzoic acid from the thermal degradation products obtained on the careful heating of isochaksine iodide at

temperatures not exceeding 250°C, as against the temperature range 300°-310°C for the pyrolysis of chaksine. Apart from *p*-isopropyl benzoic acid it was also possible in experiments to isolate a crystalline constituent which proved to be *p*-isopropyl benzamide. Further studies in the thermal degradation products of isochaksine, which are in progress, have already shown that hydrolysis of the iso-base at 200°C results as with chaksine in the formation of methyl pimelic acid and 1:2:6 heptae tri-carboxylic acid.

Project Associates: Salimuzzaman Siddiqui and Viqar Uddin Ahmed.

6. Chemical Examination of Fresh Adhatoda vasica leaves: As a part of the general-scheme to reinvestigate indigenous drug materials in the fresh-undried state the leaves of *Adhatoda vasica* were examined for their alkaloidal constituents. Vasicine and Betaine were isolated in good yields; and the isolation of the latter from fresh leaves using mildest possible methods clearly proves that it is present as such in the leaves and is not a decomposition product of vasicine, as supposed by earlier workers. No vascicinone could be isolated which lends support to the view that it may be formed through oxidation in the process of drying of the leaves or through the use of comparatively more drastic methods for isolation.

Project Associates: Salimuzzaman Siddiqui, Mir Amjad Ali and Viqar Uddin Ahmed.

7. Reinvestigation of Alkaloidal Constituents of Peganum harmala: *Peganum harmala,* which grows in abundance in Pakistan is highly reputed in the indigenous systems of medicine for the treatment of a variety of ailments. A reinvestigation its alkaloidal constituents has led to the isolation of hitherto unrecorded base, which analysed for $C_{13}H_{14}ON_2$ and has been provisionally named 'Harmidine". Studies on the chemical constitution of this base which melts 18° higher than harmaline have established it as dihydro-harmine. The chemical characteristics of harmidine and its demethylated product, harmidol melting 48° higher than the corresponding demethylation product of harmaline would make it doubtful whatever harmaline isolated from *Peganum harmala* in 1841 can be treated as a uniform chemical individual. To clarify this position, the examination of harmala seeds from other sources and further studies on harmidine are in progress. These investigations are of interest as the pharmacological studies carried out on harmidine by Nordmark Werke (Germany) have shown that it affords protection in very low doses against gamma radiation in mice.

Project Associates: Salimuzzaman Siddiqui and R. Kemal.

Publications: (*i*) Siddiqui's 'Note on Reinvestigation of the Alkaloidal Constituents of *Peganum harmala*' *Chem & Ind.* p. 356 (1962). (*ii*) Siddiqui 'A Reinvestigation of the Alkaloidal Constituents of *Peganum harmala*, *Pakistan J. Sci. Ind. Research* **5**, 207 (1962). (*iii*) Siddiqui and Kamal, R., 'A Reinvestigation of Constituents of *Peganum harmala* II' (ready for publication).

8. Chemical Examination of Snake Sloughs: In the indigenous systems of medicine and in folklore, a variety of curative properties are attributed to the shed skins (sloughs) of snakes, particularly to that of cobra. More recently studies carried out on the constituents of snake sloughs by the Japanese workers have given indications that their ether soluble component possesses marked anti-carcinogenic activity. In the light of these facts it was thought worthwhile to undertake a systematic study of snake sloughs. In planning this work, it was also considered of importance to compare the amino acid—composition of the shed skin, the live skin and the muscle, as well as the nature and extent of their organic and inorganic constituents, because such a study was likely to throw light on the excretionary processes ending with moulting.

As a result of the studies, on the shed cobra skin, the lipoid soluble portion of the skin (4.6% was found to contain 3.45% of cholesterol and 1.14% isocholesterol, as against:

	Percentage cholesterol
Alligator liver oil	0.9 — 1.0%
Fish oil (Japanese)	0.3%
Cod Liver oil	0.42 — 0.54%
Sardine oil	0.3 — 1%

There are similarities and differences in the proportion of different amino acids (15) present in the snake shed skin, the live skin and the muscle. The cystein and cystine content in the shed skin (23.7%) is very much higher than in the case of live skin (14.75%) and the muscle (19.3%). Inorganic matter is present to the extent of 0.7% on the weight of the shed skin, containing 19.76% of potassium as against 25.06% of sodium, which constitutes a considerably high proportion of potassium, for instance with reference to the Na-K balance in human sweat (0.35% sodium and 0.01-0.022% potassium). Further studies on this problem are in progress.

Project Associates: Mrs. Mashooda Hasan and M. Amjad Ali.

PHARMACOLOGICAL RESEARCH

1. Pharmacology of Isochaksine and Serpajmaline: Isochaksine, an alkaloid, is obtained from "Chaksue". The pharmacology of isochaksine and especially its cardiovascular actions were studied in dogs, cats, rats, and monkeys. The drug produced a marked lowering of the blood pressure. The exact mechanism of action of this compound was also ellucidated and found to have a central and a peripheral component. It was also found to block impulses in the autonomic ganglia.

When isochaksine was combined with serpajmaline (an alkaloidal complex obtained from Rauwolfia serpentina) which is itself a hypotensive drug, it showed a synergistic action. A combination of the two drugs was far more effective than the two drugs given separately.

The toxicity of isochaksine, serpajmaline and their combination was also worked out. The results obtained are being sent for publication.

Project Associates: M.A. Bari and Sarfaraz Siddiqui.

2. Studies on Carbinol Amine System Present in Ajmaline: Ajmaline has now been established as an effective drug for the treatment of cardiac arrhythmias. It was thought that the Carbinol amine system present in Ajmaline is essential for the antifibrillatory property of this drug. This activity is totally lost when the tautomeric carbaninol system present is destroyed by chemical means. Therefore various derivatives of Ajmaline were tested to find out the structure relationship of the compounds for antifibrillatory capability and potency.

Project Associates: Mohammad Ikhlas and Haroon-ur-Rashid.

3. Pharmacology of Antifertility Agents from "Ratti" and Jasmine: Antifertility agents obtained from *Abrus precatorius* (ratti) and Jasmine were screened for their pharmacological activity. Both the crude whole powder as well as alcoholic extract of "ratti" were investigated. The compounds were given orally to about 200 female rats, for a period of two months and the ovarian function was assessed by periodic vaginal smear examination. The animals were also allowed to mate and the percentage of animals that became pregnant was determined. It was found that about 60% of the animals who were fed on the alcoholic extract, did

not conceive. The results with the crude whole powder were not so successful. Further work is in progress to determine the possible toxic action of high doses of these compounds on various organs of the body. The mechanism of the antifertility action of these compounds is also being ellucidated.

Project Associates: S. Alam, Bukhari and Sarfaraz Siddiqui.

4. Toxicalogical Studies of Abrulin on Laboratory Animals: Toxicalogical studies of an active fraction named abrulin were carried out on four laboratory animals i.e. albine rat, rabbit, guinea pig and cat. It was found to be more highly toxic than previously reported. Abrulin was found to have haemagglutinating action which was potentiated by antivenine. Antivenine is used as an antidote to snake venom. Abrulin also produces symptoms very much similar to snake venom.

Publications: (*i*) "Studies on *Abrus precatorius* Linn. Part I—Isolation and Toxic Properties of 'Abrulin' a Protein Fraction from the seeds" by A.H. Khan, Mumtaz A. Hashmi and M. Ikhlas Khan, *Pak. J. Sci. Ind. Research* **4**, 53 (1961). (*ii*) "Studies on *Abrus precatorius* Linn. Part II— Biochemical and Pharmacological Studies on Abrulin" by M. Ikhlas Khan and A.H. Khan, *Pak. J. Sci. Ind. Research* **5**, 216 (1962).

5. Pharmacology of Antidiabetic Principles from Karella (*Momodrica charantia*): Karella is a common vegetable and its fruit enjoys some reputation in indigenous system of medicine as an antidiabetic agent. An anti-diabetic factor, provisionally named as Karellin was isolated from Karella under the guidance of Dr. Salimuzzaman Siddiqui. Further work to assess the values of Karellin in the chemotherapy of Diabetes mellitres is in progress.

Another component from Karella has been isolated. Though Karellin has no effect on the blood sugar level of normal animals, the new component appears to be different from Karellin in as much as it lowers the blood sugar of normal animals. Detailed investigations are in progress to find out the probable mechanism of action of this component.

Project Associates: Abuzar and Sarfaraz Siddiqui.

6. Studies on Mammalian Toxicity of Makrolin: Insecticides when used easily come in contact with human beings and animals, endan-

gering their lives due to slow gradual accumulation. It was therefore found necessary to carry out mammalian toxicity tests for Makrolin.

Toxicity experiments were done on albino rats by oral route. It was found that LD 50 of Makrolin was 3200 mg/kg, which is less than usual insecticides like D.D.T., Aldrin, Dieldrin, Heptachlor, B.H.C. and Toxaphane.

Project Associates: Shahid H. Ashrafi and Mohammad Ikhlas Khan.

7. Pharmacological Studies of Salts of Chaksine and Isochaksine: Preliminary pharmacological studies of various salts of chaksine and isochaksine were carried out. Isochaksine was found to have a blood pressure reducing property more than chaksine sulphate. But it was more toxic than chaksine sulphate. More experiments are needed to elaborate the mechanism of its various actions.

Project Associates: Mohammad Ikhlas Khan, Haroon-ur-Rashid and Saleem Mir.

8. Domestic Water Filter: The experience gained in controling the porosity of the ceramic materials was extended to the development of a domestic water filter. A number of compositions were tried, and their power to remove pathogenic bacteria assessed in the pharmacological section. The work has been delayed due to the absence of one of the team members who is on study leave abroad.

Project Associates: Riaz Ali Shah, S. Tehzibul Hasan, Mohammad Aslam and M. Ikhlas Khan.

BUILDING MATERIALS

1. Roof Construction: (a) Roof Slabs in Low-cost Houses: Roofs have been given much attention in the construction of low-cost houses, as these involve, to a greater extent, the use of mild steel, at present an imported material. The use of thin concrete tiles over precast reinforced concrete battens reduces the cost and the use of reinforcing steel. The modification is based simply on economy in construction and the important factor of thermal comfort was totally neglected. The precast units need water proofing layer also. An attempt has therefore been made to design and test a type of roofing that can cut down the cost without affecting comfort in houses. The design of the roof based on flexural strength of concrete, which has been discussed in detail, reduces the quantity of steel from approximately 170 lbs. for the construction of a single room of $10' \times 11'$ inside dimensions to about 34 lbs. without any change in the quantity of concrete. This design does not need any water proofing layer. The roof was tested upto a load of 360 lbs. per sq. ft. and no sign of a failure was observed.

Publication: 'Roof Slabs in Low-cost Houses' by S. Tehzibul Hasan. *Pakistan J. Sci. Ind. Research* **1**,4 (1961).

(b) Plain Concrete Vault Roofs: Two types of vault roofs with uniform and varying arch thickness were laid on rooms ($10'3'' \times 11'7''$ inside dimensions) and tested under a uniformly varying superimposed load of sand bags. The low deflection under a high test load indicates the suitability of the design for single storey houses. Because of its shape, there is no possibility of water accumulating on a vaulted roof and therefore, no water proofing is required. By providing a ventilation shaft on top of the roof, the stack effect (natural ventilation) can be considerably increased without any increase in expenditure of raising the walls and taking the ventilators to the ceiling height.

Publication: 'Roof Slabs in Low-cost Houses. Part I-Plain Concrete Vault Roofs' by S. Tehzibul Hasan. *Pakistan J. Sci. Ind. Research* **5**,133 (1962).

2. Concrete and Aggregate (*a*) Integral Waterproofers for Concrete: The wide and increasing use of Portland cement in modern

buildings has made possible and desirable departures from the older methods of waterproofing and led to the adoption of integral methods, to which cement concrete and rendering are particularly suited. The following projects are under investigation at these laboratories.

(i) Influence of Integral Waterproofers on the Physical properties of Cement and Concrete: The influence of integral waterproofing powders, particularly 'CEMTO' developed by PCSIR and an imported product, on the physical properties of cement and concrete has been investigated. These compounds do not have any appreciable influence on the setting properties of Portland cement so as to cause any construction problem. They, however, reduce the compressive strength of the concrete, but are effective water-repellent materials. Suitable amount of 'Cemto' required for different applications have been worked out.

Project Associates: Tehzibul Hasan, M. Aslam and S. Mussarrat Hussain.

(ii) A Liquid Composition for Integral Waterproofing of Concrete: A composition composed of surface tension reducing materials, stabilisers and accelerators has been developed which gives the desired waterproofing properties and does not reduce the strength of the concrete. Pilot plant studies are being carried out to study the economics of the process.

Project Associates: Tehzibul Hasan, S. J. Quadir, M. Aslam and R. A. Shah.

(iii) Studies in the Mechanism of Waterproofing of Concrete: Surface tension measurements of different waterproofing agents using DU Nouy Tensiometer are being made in order to understand the mechanism of waterproofing of concrete and give a possible physical interpretation for the waterproofing of concrete. The temperature dependence of this function would possibly give the energetics of the process.

Project Associates: S. J. Quadir and R. A. Siddiqui.

(b) A comparative Assessment of Malir Sand as a Fine Aggregate in Building Construction: Many types of aggregates, both natural and artificial, are used in building construction. Fine aggregate or sand is defined as an aggregate made up mainly of particles below 3/16 inches in size. Malir sand, which is extensively employed as a fine aggregate,

is a calcareous aggregate consisting of 59.85 percent of calcium carbonate and 31.57 percent of silica. Although low silica content is not considered desirable, nevertheless Malir sand is being extensively used and gives good strength with Portland cement. A detailed investigation of the physical as well as chemical characteristic has been taken in hand in order to determine the reason for the superior behaviour of this sand in spite of the unfavourable indications of the chemical analysis. Siliceous river bed sand from the Ravi river is being used wherever necessary for comparison of different characteristics. The paper has been sent for publication.

Project Associates: Riaz Ali Shah, S. Tehzibul Hasan and Mubarak Ahmad.

(c) Flexural Strength of Plain Cement Concrete: In an earlier communication on roof slabs in low-cost houses, the flexural strength has been utilized in designing the reinforced concrete roof slabs to minimize the use of mild steel to a great extent. This property is rarely used to measure the quality of Portland cement concrete. However, in designing runway and road pavements, this is very important as the slabs in these constructions seldom fail in compression. The study of this property using local aggregates and cement has therefore been taken in hand. The factors affecting the compressive strength also affect the flexural strength and there is a considerable relation between the two strengths. A paper has been sent for publication:

Project Associate: S. Tehzibul Hasan.

3. Cements: (a) Pozzuolanic Cements: Alkalies in Portland cement react with the siliceous constituents of aggregate, with consequent deterioration of the concrete. This reaction can be controlled by replacing a part of the cement by pozzuolanic material. A pozzuolana may be defined as a material which, though not cementitious in itself, contains siliceous constituents which will combine with lime at ordinary temperatures to form cementing products related to those in the set Portland cement. Pozzuolanic materials reduce the evolution of heat of hydration and the hardened concrete is more resistant to chemical attack. The effect of brick dust (surkhi), an artifical pozzuolana, when replacing the cement and clinker from 5 to 30 percent is being studied on the setting, heat of hydration, strength and resistance in sulphate solutions of concrete. Pozzuolanic cements give lower strength at 28 days than the Portland cements. The aggregate

used in these experiments is local obtained from Malir river bed which is calcareous in nature.

Project Associates: S. Tehzibul Hasan and Mahboob Ali Shah.

(b) SULPHATE RESISTING CEMENTS: Cement concrete is attacked by certain types of soil, which contain corrosive chemicals especially soluble sulphates. These attack the lime in concrete to form calcium sulphate which in turn attacks tricalcium aluminate to form calcium sulpho-aluminate. The latter (an alum) expands greatly on absorbing water and leads to disintegration of the concrete. The effect of certain mineral additives has been studied on setting, strength and expansion in sulphate solution of cement mortars. Patent coverage is being obtained.

Project Associates: Riaz Ali Shah, S. Tehzibul Hasan, Mohammad Aslam and Mubarak Ahmad.

(c) HIGH EARLY STRENGTH CEMENTS: The addition of sodium sulphate in concrete mixes has been reported to increase early strength and chemical resistivity. Our preliminary investigation shows that the local calcareous aggregate obtained from Malir river bed when bonded with local Portland cement gives a sulphate-resistant concrete, and the sodium sulphate addition in the mix neither increases early strength nor sulphate resistance. The effect of other salts is under study.

Project Associates: S. Tehzibul Hasan and Mussarrat Hussain.

(d) THE INVESTIGATION OF A RED CLAY FROM SALT RANGE AREA AS NATURAL POZZUOLANA IN CONSTRUCTION CEMENTS: A red clay from Kuruli Salt Range of Jhelum has been found very useful as partial replacement of Portland cement. This clay from 10 to 30% by weight of cement increases early strengths and waterproofing properties of cement concrete. The results are similar in calcareous and siliceous aggregates. The heat of hydration and sulphate resistance is reduced. The heat of hydration at 7 and 28 days was determined by the heat of solution method described in A.S.T.M. Designation: C-186 (55) with slight modification as the ignition loss of this clay is very high.

Project Associates: Karimullah, S. Tehzibul Hasan and Mahboob Ali Shah.

4. LIGHT-WEIGHT BUILDING MATERIALS: (a) NEAT CEMENT CELLULAR CONCRETE: The details of preparation, control of density and examination

of physical properties of cellular concrete have been published. Further work with modified "balcrete" has shown that the consumption of foaming agent is reduced from 2-3 to 0.5-0.75 percent by weight of cement using ordinary non-tilting concrete mixer.

Publication: 'Utilisation of Balcrete Foaming agent Part-I. Production of Cellular Concrete (with neat cement)' by Mohammad Aslam, S. Tehzibul Hasan, Mubarak Ahmad & M. Jahangir, *Pakistan J. Sci. Ind. Research* **4**,9 (1961).

(b) Cement-sand Cellular Concrete: It has been reported that the river sands can be incorporated with cement for the preparation of cellular concrete. The present study was undertaken to work out the details of preparation and physical properties of moist cured cement-sand cellular concrete. The fine siliceous sand from Ravi river bed and coarse calcareous sand from Malir river bed were mixed in different proportions with Dalmia portland cement. The fine river sand gave better and uniform results.

Publication: 'Utilization of Balcrete Foaming Agent' Part-II. Production of Cellular Concrete with Cement-sand Mix' by Mohamad Aslam, S. Tehzibul Hasan and Mohammad Jahangir, *Pakistan J. Sci. Ind. Research* **5**, 112 (1962).

(c) Ordinary Clay Cellular (Burnt) Bricks: During pilot plant studies, it was found, that 'Balcrete' (Foaming agent for cellular cement concrete) did not give satisfactory results below 50 lbs. per cu. ft. However the use of a new foaming agent, Foamex-C has made it possible to make bricks of any desired density. The patent application for new process based on the utilization of foaming agent has been filed. It is proposed to carry out the pilot plant studies for the manufacture of cellular clay bricks and in the meantime, the physical properties are under investigation.

Patent: Pakistan Patent No. 11852, dated 19.6.1962.

Project Associates: S. Tehzibul Hasan, R. A. Shah, Mohamad Aslam and Hasan Imam.

5. Marbolite (A new Synthetic Marble): The term marble is derived from a Greek word meaning to sparkle or flash because the calcite crystals in marble sparkle as they reflect light. In its geological sense, the term is applied to rocks comprising crystallised grains of calcite and or dolomite, but commercially the word has a wider connotation. As the ability to take polish is the chief commercial asset of marble, all calcareous rocks that can be polished are regarded as marbles in the trade. Even

Mr. Abul Kasem Khan, former Minister of Industries (second from left in the far row) presiding over the 13th Meeting of the Governing Body of the Council.

Mr. Akhtar Hussain, former Minister of Education in the Pharmaceutical Division of the Central Laboratories.

U. A. R. Scientists in the Central Laboratories.

Prof. Abdus Salam, Scientific Adviser to the President of Pakistan is taken round some of the research units of the Central Laboratories.

some serpentine minerals which have attractive colours and patterns and can be polished are classified as marbles although they contain little calcium or magnesium carbonates.

Since marble is expensive, many attempts have been made to produce substitutes, and several methods are claimed to produce materials with marble finish by cold-setting processes using magnesium oxychloride, white Portland cement in conjuction with ground quartzite, marble dust or stone powder, plaster of paris or keen's cement and sand or stone with soluble silicates. However, the physical properties of these compositions, e.g. compressive and flexural strength, surface hardness, machining qualities, water absorption are far inferior to those of natural marble. A high temperature process for synthetic marble has been developed at these Laboratories, and the product has the properties of natural marble, being moreover superior in respect of heat and acid resistance. It has been named "Marbolite". The basic raw materials required for this process are baryte and celestite, both being abundantly and cheaply available in the country.

The cost of marbolite is expected to be about Rs. 0.80 as against Rs. 8.00 to Rs. 10.00 per sq. ft. of the natural marble in Pakistan, and its manufacture on industrial scale can bring marble-like flooring and wall-facing within the reach of the middle income groups in their house building programmes. A paper has been sent for publication.

Patent: Pakistan Patent No. 112179 dated 5.10.62.

Project Associates: Mohammad Aslam, S. Tehzibul Hasan, Riaz Ali Shah and Z.N. Zaidi.

6. Light-weight Insulating Refractory Brick: A new process has been developed at the Central Laboratories for the manufacture of insulating fire bricks. Stabilised foam is incorporated in the fire clay mass which makes the process independent of the plasticity of the clay. Grog can be introduced and the porosity of the fire bricks can be controlled according to the nature and purpose for which the bricks are to be used. A number of compositions were formulated by varying the fineness and proportion of the grog, keeping the density of the brick constant. Similarly the density of the bricks was varied for particular clay-grog ratio.

Cones made from these bricks were found to be unaffected by temperature upto 1600°C.

Project Associates: Riaz Ali Shah, S. Tehzibul Hasan, Mohammad Aslam and Hasan Imam.

7. Possible uses of Clifton Sand in Building Industry: (a) in Thermal Insulating Materials: Mica or micaceous substances are known to be used for the manufacture of insulating bricks, slabs, tiles or like products. A black and lustrous coastal sand found over a ten mile stretch along the Clifton beach (Karachi) contains 43-45 per cent micaceous material, and its grading resembles that of a fine dune sand. The high content of micaceous material, large proportion of shell fragments, fine grading and the presence of injurious sea salts make this sand unsuitable for ordinary constructional purposes, but its specialized uses may be possible.

The results of a study carried out on this coastal sand for use in thermal insulating materials indicate, that cellular concrete having a density of 30 pounds per cubic foot and containing 25 per cent Clifton sand mixed with Portland cement, has a thermal conductivity nearly equal to that of cork. This micaceous sand when bonded with ordinary clay can be advantageously used in the manufacture of insulating bricks for use in buildings and secondary lining of high temperature furnaces.

Sodium silicate as a binding agent gives very high strengths, and therefore this sand when bonded with sodium silicate will meet the requirements of heavy floors. The sand can also be filled under plinth for ground floor and in cavity wall constructions for thermal insulation purposes. A paper is being submitted for publication.

Project Associates: S. Tehzibul Hasan, Mohammad Aslam and Hasan Imam.

(b) As Partial Replacement of Portland Cement: The effect of Clifton sand fired at 800, 1000 and 1200 degrees centigrade as partial replacement of Portland cement in varying proportions from zero to fifty per cent on the strength of 1:2:4 cement concrete has been studied. The Clifton sand sample fired at 1200°C gave the best results of strength and pozzuolanic reactivity. The 20% replacement of cement with crushed Clifton sand fired at this temperature appears to be most effective as the rate of increase of strength in this case is better than that of the normal concrete.

Project Associates: S. Tehzibul Hasan and Moinuddin Khan,

8. SAND—LIME BRICKS: The sand-lime brick is a recently developed building material which is made by moulding a mixture of siliceous sand and hydrated lime and then hardened by steam pressure. In the moist heat provided by steam, the surface of the silica grains become slightly soluble, and are easily attacked by the lime present. This project has been started recently as good clay for brick making and aggregate for construction is not available in many parts of the country. The preliminary investigations in this context reveal that even calcarious aggregate can be used successfully in the production of sand lime bricks. The work on minimizing the steam pressure required for hardening is in progress.

Project Associates: S. Tehzibul Hasan and M. A. Ghani.

CHEMICAL ENGINEERING AND PILOT PLANT STUDIES

The work of the Chemical Engineering and Pilot Plant studies may be divided into the following heads:

1. Projects under Development and Investigation.
2. Design and Fabrication of Plants and Equipments.
3. Pilot Production.
4. General.

1. PROJECTS UNDER DEVELOPMENT AND INVESTIGATION: (a) PESTICIDES—MAKROLIN: (i) FROM A WASTE BY-PRODUCT (GASOLINE) OF AMMONIUM SULPHATE INDUSTRY AT DAUDKHEL: Laboratory experiments were repeated on a semi-continuous chlorination apparatus of 1 litre/24 hours capacity. Variables such as gas-rates, alkali concentration and different metal catalysts affecting the overall period of chlorination were studied.

Another plant of about 10 litre/24 hours capacity has been set-up to study the commercial feasibility of the process. The results thus obtained have been used to design a 0.1—0.2 tons/24 hours pilot-plant which will be imported and installed at the new site of the Central Laboratories.

Project Associates: S. Siddiqui and S. A. Qureshi.

(ii) FROM PETROL-PETKOLENE: Besides 'gasoline' which is a waste by-product of the Ammonium Sulphate Industry, various fractions of the indigenous petroleum have also been subjected to chlorination under certain experimental conditions. These chlorinated fractions have shown relatively good insecticidal values. Further work on improving the method of chlorination and determining the entomological properties of these fractions is in progress.

Project Associates: S. Siddiqui and S. A. Qureshi.

(b) 'KARELLA' EXTRACT FOR PRODUCTION OF AN ANTI-DIABETIC DRUG: A unit for 'Karella' concentrate needed for the preparation of an antidiabetic drug for large scale pharmacological studies was set up. About 35 batches of fresh Karella were extracted with solvents and the extracts were concentrated

under reduced pressure. The following units were designed and fabricated for the project: (*i*) Automatic Slicing Machine (*ii*) Dialysis Apparatus with five chambers and provided with 2 independent strirrers in each compartment, to run with a centralized driving device under variable speed control. Concentration of the extracts after suitable purification was also carried out in specially assembled thin layer evaporators.

Project Associates: Hashim Mohammad Ali and S. M. Ishaq Ali.

(c) CHEMICAL COMPOSITION OF GASOLINE: The precise chemical composition of the 'Gasoline' has not been established so far. Efforts are being made to convert the whole of the 'gasoline' into solid chloro-compounds and then identifying these compounds individually. Catalytic chlorination has been used, which partly converts gasoline into solids—mostly hexachlorobenzene. Further work is in progress.

Project Associates: S. A. Qureshi and Iqbal Ahmed.

(d) FLOW OF FLUIDS THROUGH COILS: In order to establish a relationship between the pressure drop per unit length and the Reynold's Criterion, the fluid flowing through the vertical coil, the ratio d/D where d is the tube and D is the coil diameter. Experiments are in progress.

The present study is restricted to small coils where d varies from 0.2 to 0.6 cm. and D from 2 cm to 4 cm.

Project Associates: S. A. Qureshi and Swafan Ibne Aziz.

(e) PLANT FOR PRODUCTION OF ROSIN OIL: A special distillation plant was designed and fabricated for the production of rosin oil, for 'Cuprex'—a wood preservative. The plant comprises an enclosed heating vessel of a capacity of 150 lbs. of rosin, a combination chamber of oil burner with blowing equipment, water condenser and two vertical and horizontal air condensers. It has a capacity of handling 2 batches of 150 lbs. of rosin in about 8 hours. Various fractions of the rosin oil can be collected under different temperatures without much difficulty.

Thirty three batches of more than 4,700 lbs. of raw rosin were successfully run under controlled conditions, and about 6 to 7 fractions were separated from each batch. The actual recovery of oil was above 92%.

Project Associates: S.M. Ishaq Ali, M. Abul Hashem and M. Aslam.

(f) Flue Jacketed Hot Roller Press: A Flue Jacketed Hot Roller Press was designed for the production of beedi leaves. The design has been patented:

Patent: "Flue Jacketed Roller Press" by Abdul Hamid Chotani and S.M. Ishaq Ali. Pakistan Patent No. 112381, (December 1962).

(g) Activated Fuller's Earth: The previous work on the activation of Multani Mitti was not economically feasible because of the high acid consumption. Locally available bentonites have been investigated and found that they can be commercially used for the production of Activated Fuller's Earth. The process is ready to be leased out for commercial exploitation.

Project Associates: Karimullah, R.A. Shah, M.K. Bhatty and Nasir-ud-din Zahid.

2. Design and Fabrication of Plants and Equipments: (a) Basket type Centrifugal Machine: A basket type centrifugal machine indirectly driven by a 3 H.P. motor has been designed and fabricated for miscellaneous industrial-scale trials. The capacity of the centrifuge is about 20 lbs. per charge. The machine is provided with a very effective drum-type brake.

(b) Rotary Dryer: A rotary dryer has been designed and fabricated for the Drugs and Pharmaceutical Division with the provision of a variable speed control and a vacuum connected with the gas tight rotary seals.

(c) Foam Generating Machine: A Foam generating machine has been designed and fabricated in the Engineering Division. The machine has a capacity of producing 50 cu. ft. of foam concrete per hour. Many machines were produced and supplied to various parties. Their use has reduced the consumption of Foaming Agent from 2% to 0.25%.

(d) Wood Working Lathe: A Low Cost wood working lathe which has novel features has been designed and fabricated in this Division. The machine is simple in construction and easy to operate.

(e) Apparatus for Percolation Tests of Building Materials: An apparatus for percolation tests of 12 specimens at a time has been

designed and fabricated in the Engineering Division, to determine percolation of each test piece under various heads.

3. PILOT PRODUCTION: During the period under review the following items were produced and sold for consumer testing:

(*i*) Balcrete—Air Entraining Agent, 40,000 lbs.

(*ii*) Fixempero—Gypsum Based Distemper, 10,000 lbs.

(*iii*) Cuprex—A Wood Preservative, 4000 lbs.

4. GENERAL: One of the major functions of the Chemical Engineering and Pilot Plant Section is to provide considerable technical assistance and guidance to industrialists to whom Council's processes are leased out and to put them in final prodution.

During the period under review the following processes were put into production.

(a) HYMAX—FISH LIVER OIL: (Lessee M/s. Pakistan Vitamin Products). The erection of the entire plant had to be carried out by the engineers of this section. Some of the units required for the processing were fabricated in the workshop. Several other alterations, additions and modifications of the important parts were carried out to put the process in production in November, 1962.

(b) GAS GENERATING PLANT: (Lessee: M/s. Consolidated Products). All the production staff were trained to produce the gas generating plant. The process has been in production since June, 1961.

(c) BALCRETE—AIR ENTRAINING AGENT: (Lessee: M/s. Shaikh Gulzar Ali & Co.) The process went into commercial production in October, 1962.

(d) CEMTO—AN INTEGRAL WATERPROOFING COMPOUND FOR CEMENT AND CONCRETE: (Lessee: M/s. Pakistan Waterproofing Co.) The process went into commercial production in March 1961.

FUEL RESEARCH

1. Studies on Desulphurisation of Pakistan Coals: (a) Laboratory Experiments with Sui Gas and Flue Gases: In continuation of the previous work on the efficiency of superheated steam as desulphurising agent for high sulphur coals, several new approaches have been tried. National Sui-gas being readily available, its influence on the coal was studied at temperatures varying from 300°C to 1000°C. At a temperature above 300°C. 20% desulphurisation was found to occur, while between 800—900° only a trace of sulphur remained in the residue and carbon monoxide and hydrogen were evolved alongwith hydrogen sulphide, and saturated and unsaturated hydrocarbons.

The experiments with Sui-gas were then repeated with bubbling the gas through boiling water. It was observed that at a temperature below sub-carbonisation point, 12 percent reduction was obtainable. Between 600 to 800 there is a slow increase from 3.3% to 7.788% of sulphur. Above 800°C and below 900°C only a trace of sulphur remains. Gas analysis of the exit gases indicated the presence of carbon monoxide, hydrogen sulphide, saturated and unsaturated hydrocarbons and hydrogen. Since the analysis was complete, its C.V. could not be determined.

A number of experiments were also carried out with an ideal mixture of flue gas composed of carbon dioxide and nitrogen in the ratio 1:4. It was observed that about 36 per cent of reduction in sulphur takes place provided that the gases are introduced after bubbling nitrogen through boiling water, and the temperature of the oven is maintained below the sub-carbonisation point.

Fractionation of 'Makerol' has been carried out and bromine numbers and sulphur contents are now being investigated. Further experiments are in progress.

Project Associates: S. Siddiqui, M. Naseem Ahmed and S. Sultan Ahmed.

(b) Fluidization Studies for Pilot-plant: In order to establish the optimum working conditions for different coal samples for fluidisation, experiments were carried out on 2.5" (I.D) tube with gases of different densities and viscosities at different height of the bed and with different sizes of coal particles. As a results of these experiments it was concluded that:-

(*i*) The gas velocity required to produce a given state of fluidisation can be calculated on the basis of known relations between the gas velocity and pressure drops through static beds.

(*ii*) The value of constant is directly proportional to the diameter of the column.

Further experiments in order to examine the relationship between the gas velocity and the state of fluidization are in progress.

Project Associates: M. Naseem Ahmed, Himayat Ullah and I.K. Pathan.

2. Low Temperature Carbonisation of Low Rank Coals from Baluchistan: A series of experiments for low temperature carbonisation and desulphurisation of Baluchistan coals (which are low in sulphur) are in progress. The tarry matter which distills along with hydrogen sulphide gas could be used as a binder for making briquettes of the residue.

Project Associates: M. Naseem Ahmed and Azhar Habib.

3. Studies on the Mineral Matter and Deashing of the Pakistan Coals: Experiments on gravity separation of different coal samples have been done in order to obtain some information about the composition of mineral matter and to establish a relationship between its compositions and the decomposition points of ash. By applying improved methods of chromatography, the composition of the mineral matter has been estimated qualitatively, and the results published. Further work is in progress.

Laboratory scale experiments on five coal samples were also carried out. The results obtained have been reported. Further experiments on semi-pilot plant scale shall be taken up as soon as the apparatus is fabricated locally.

Project Associates: S. Siddiqui, M. Naseem Ahmed, Raza Mohammad Khan, Zahid Raza, B. Hasan and S.B. Hussain.

4. Gasolines from Pak-American Fertilizer Factory at Daudkhel: The hydrocarbon groups that are present in the gasoline like by-products from the fertilizer factory are as follows: Saturated hydrocarbons 27.19%; unsaturated hydrocarbons 56.56%; aromatics 16.37%.

The bromine number of the substance was also estimated and found to be very irregular with the rise of the boiling point of each fraction.

All the fractions from a range of 35.5°C—140°C with difference of 10°C in their boiling point were tested for the presence of per oxides by I.P. method. It was also found that by the elimination of diolifines the colour is stabilized. Elimination of diolifines and addition of the antioxidant (Topanol-A) reduce the gum forming tendency. Refractive index estimates for different fractions were carried out at 20°C. For a fraction in the range 160°C—180°C it was 1.478.

Project Associates: M. Naseem Ahmed and S.M.I.R. Shah.

5. Studies on Tar from Daudkhel Fertilizer Factory: Studies on the utilization of tar obtained as a by-product at Daudkhel fertilizer factory are in progress. Fractionation of tar upto a temperature of 250°C has been carried out with 10 degrees difference.

The residue is obtained in the form of a pitch which can be utilised as a binder or active carbon.

Project Associates: K.V. Ahmed Mustafa and M. Naseem Ahmed.

PAINTS AND PLASTICS

(1) Natural Resins: (a) Rosin Esters of Betulin: Pure betulin or extract of the bark of the *Betula utilis* known locally as 'bhoj putr' or 'Khadang' can be condensed with rosin to prepare esters. It has been found that scratch hardness values of these new resins are nearly the same as that of estergum but low in comparison with pentaerythritol ester. Their water resistance properties are comparable with pentaerythritol ester. The polymerisation rates are intermediate between those of ester gum and pentaerythritol ester. Perhaps the most interesting part of the results is the excellent water resistance of varnishes based on the new ester prepared from extract of the bark as such. On the other hand, those varnishes dry slowly but this can be corrected by using slight quantities of driers.

Patent: "A process for the production of rosin esters of betulin and coating compositions prepared there-from" by S. Siddiqui M. Aslam and Khurshid Alam. Pakistan Patent No: 110806 dated 27.9.1960.

Publication: "Properties and Applications of Betulin based Rosin Esters" by Mohammad Aslam and Khurshid Alam, *Pak. J. Sci. Ind. Research* **2**, 62 (1961).

(b) Stable Metallic Soaps of Rosin Acids and Their Derivatives: The results of these investigations have been published.

Publication: "Preparation of Stable Metallic Soaps of Rosin Acids and their Derivatives" by Mohammad Aslam and Ashhad Mehdi, *Pak. J. Sci. Ind. Research* **4**, 57 (1961).

(c) Rosin Modified Maleic Resins: The two outstanding properties that have given maleic resins a unique place in surface coatings are (1) light colours and comparative freedom from the yellowing, a characteristic of phenolic resins and (2) extreme compatability with nitrocellulose in the manufacture of lacquer, whereas pentaerythritol resins, which are formidable competitors in the varnish field, are incompatible in this respect. These resins are prepared by reacting together rosin, maleic anhydride and glycerol. Theoretically three type of reactions are involved in this preparation. (1) Esterification of the bibasic and monobasic acids by glycerol (2) Formation of an adduct of maleic anhydride with the rosin acids by addition reaction akin to Diels-Alder reaction. (3) Condensation

reaction between maleic anhydride and glycerol in accordance with Kienles' concept of functionability. Even though several methods have been suggested for preparation of maleic resins, the present work appears to be the first systematic investigation of the influence of various methods in their application in surface coatings.

Publication: "Studies on the Influence of the Methods of Preparing Maleic Resins on their Application in Surface Coatings" by Mohammad Aslam and M. Hussain, *Pakistan J. Sci. Ind. Research* **5**, 108 (1962).

(2) Condensation Products of Betulin and Fatty Acids: It has been observed that fatty acids react with betulin at higher temperature to produce a new series of oils, which are expected to find several industrial applications. The study of the properties of linseed betulin esters with respect to this application in surface coatings and printing inks has been completed. The work is being extended to the study of esters made from cottonseed and castor fatty acids. Patent coverage for the basic fatty acids-betulin reaction is being obtained.

Project Associates: S. Siddiqui, M. Aslam, Khurshid Alam and Salim Akhtar.

(3) Utilisation of Cottonseed Products for Paints, Enamels and other Coatings: (a) Cottonseed Oil Based Coating Compositions and Paints: The results of the study of various factors leading to the successful utilisation of cottonseed oil has been sent for publication.

The maximum proportion of oil that can be combined with rosin in these formulations is 1.5 parts oil to 1.0 parts of the resin. The use of maleic anhydride to increase the proportion of oil in cottonseed oil based varnishes has been investigated. It has been observed that the proportion of the oil can be increased to 4.0 parts oil to 1.0 part resin, and some of these compositions possess improved physical properties like water resistance, scratch hardness etc.

Patents: S. Siddiqui and Mohammad Aslam. Pakistan Patent No. 108246 dt. 5.4.1957, Indian Patent No. 60100 dt. 3.4.57, British Patent No. 813955 dt. 23.4.57, Australian Patent No. 218208 dt. 8.4.57, Canadian Patent No. 592615 dt. 5.4.57.

(b) Utilisation of Cottonseed Fatty Acids Pitch: The results of these investigations have been published.

Publication: "Utilisation of Cottonseed Fatty Acid Pitch for the Preparation of Black Stoving Enamel" by Mohammad Aslam and G. Mustafa Ali, *Pakistan J. Sci. Ind. Research* **4**, 83 (1961).

(4) Preparation of Stand Oil: Stand oil is generally prepared by polymerising linseed oil under an inert atmosphere and is predominatly used for the manufacture of printing inks. It should possess a good colour and low acid value. Preliminary examination of indigenous linseed oil, which has comparatively lower iodine values, showed that on polymerisation in an atomosphere of carbon-dioxide, it developed dark colour and high acidity. Use of high vacuum appears to be the only promising method for the utilisation of the indigenous linseed oil, and this has been studied in detail.

Project Associates: Mohammad Aslam, G. Mustafa Ali and Mir Mahmood Ali.

(5) Gypsum-based Dry Distemper: Dry distempers based on whiting with casein, the protein content of milk, as a binder have been commercially produced since the turn of the present century. It is necessary to add lime and alkalies in these formulations to help the casein go into solution on admixture with water. Opaque pigments like lithopone are included to give better opacity and finishing properties. Both whiting and the pigments are imported in the country for this purpose.

Calcined gypsum has not been hitherto used for the manufacture of dry distemper because (*i*) when applied as a thin film, the calcined gypsum does not adhere to concrete, (*ii*) setting properties of calcined gypsum are destroyed by addition of proteins. As a result of the research work being carried out on utilization of gypsum, a new composition for dry distemper based on this mineral has been evolved. The new product, "Fixempero", is superior to the presently available dry distempers in the market. Opaque pigments can be used with gypsum in the new formulation but are not essential for good finishing properties.

'Fixempero' is suitable for use on Portland cement renderings, concrete products, burnt clay bricks, blocks, gypsum plasters and wood. It may be used over a lime coat but in no case must it be used on colour washes which have been applied after incorporation of animal glue. The film is hard and strong and becomes rub-resistant within two hours of application. It possesses good decorative qualities as to hiding power and

colour . In respect of water-repellent qualities, it compares favourably with Portland cement based paint.

The covering capacity of 'Fixempero' is 50-60 sq. ft./lb, which equals the marketed distemper. Pilot Plant for the manufacture of the new product was set up, and about 10,000 lbs. have so far been produced and sold to different consumers. The process has now been leased out to two parties in West Pakistan for commercial exploitation.

Patent: "A Process for the Producion of Dry Distempers" by Mohammad Aslam and S. Tehzibul Hasan. Pakistan Patent Application No. 534/62 dated 11.6.62.

(6) Substitute for Portland Cement based Paints: White Portland cement is commonly used for formulation of cement paints, but is not produced in the country. A composition based on 'pozzuolana' type of cements, suitably accelerated to set within 2-4 hrs., has been evolved, and appears to be very promising. Exposure trials are in hand.

Project Associates: Mohammad Aslam and S. Tehzibul Hasan.

(7) Preparation of Dry Colours for Portland Cement based and Oil Based Paints: Dry colours used for these paints have generally been imported in the country. They are usually composed of basic pigments and fillers, which are incorporated partly to give specific properties suitable for end application and partly for dilution. The quality of the local products manufactured by M/s. Karachi Paint Industries was not comparable with the imported products, and the party referred the problem of upgrading their quality to these laboratories. As a result of the study carried out here, it was possible to improve the existing formulations to bring their quality at par with the imported products. The details of the investigation have been handed over to the party against payment.

Project Associates: Mohammad Aslam and A. Ghafoor Butt.

(8) Foaming Agent Compositions: A foaming agent ('Balcrete') for production of cellular concrete was developed and put into pilot plant production as early as 1957. This composition has been further modified to reduce the consumption from 1.5–2% to 0.25-0.75% by weight of cement. About 40,000 lbs. of Balcrete were produced on the Pilot Plant, and sold to various Government departments and private construction companies. The product has been in commercial production since Oct.

1962 by M s. Gulzar Ali & Co. Further work in this field has led to the development of Balcrete in powder form on which Pilot Plant trials need to be carried out.

Foams produced from Balcrete are not stable enough for production of cellular clay bricks. An improved composition (Foamax-C) has been developed and it has been found useful for this particular purpose.

An ad-hoc problem on a composition for fire fighting foaming agent has also been under investigation.

Patents: (1) "A Process for the Production of a Foaming Agent for Cellular Concrete" by S. Siddiqui. Mohammad Aslam and S. Tehzibul Hasan. Pakistan Patent Application No. 759/62 dated 17.8.62. (2) "A Process for the Manufacture of a Foaming Agent for Cellular Clay Products" by Mohammad Aslam. S. Tehzibul Hasan and R. A. Shah. Pakistan Patent Application No. 110/63 dated 13.2.63. (3) "A Process for the Production of Dry Foaming Agent for Cellular Concrete" by S. Siddiqui, Mohammad Aslam and S. Tehzibul Hasan. Pakistan Patent Application No. 1064/62 dated 17.11.62.

(9) Manufacture of Liquid Gold: It has now been found possible to prepare stable organic complexes of these metals which are required in the formulation of liquid gold. Work on testing their stability on intermixing is being continued.

Project Associates: Karimullah, Mohammad Aslam, R. A. Shah, and Ashhad Mehdi.

(10) An Improved Wood Preservative: "Cuprex" has been developed as a substitute for copper naphthenate. Whereas creosote can be effectively used only by pressure impregnation. "Cuprex" can be used by brushing. spraying and dipping techniques. This is of special significance in our country where it will be far more easier and economical for consumers to use this preservative on site. Cuprex can also be used for treating textiles and Jute bags. etc. It is now being produced on pilot plant scale. and about 4000 lbs. were sold. The process has been advertised for leasing out.

Patents: "An Improved Wood Preservative" by S. Siddiqui, Mohammad Aslam and Ashhad Mehdi. Indian Patent No. 60367: Pakistan Patent No. 108270.

(11) LEATHERS FROM SHARK SKINS: It is estimated that about 500 tons of shark skins are converted into fish meal. Since this material can be used for making beautiful leathers, investigations have been carried out on the different species for its curing and storage characteristics. Different methods of tanning fresh and cured shark skins with vegetable, synthetic and chrome tanning materials are under examination.

Project Associates: M. Jamil Khan, Ajmal Khan and Shafiur Rehman.

(12) UTILISATION OF BABUL BARK FOR TANNING: Babul bark when used alone for tanning of heavy and light leathers does not give satisfactory results. Work is being continued on the utilization of this bark with a view to assess the maximum percentage of babul bark tannins that can be used in conjuction with other tannins prepared from mimosa and myrabolans without impairing the quality of leather.

Project Associates: M. Jamil Khan and M. Shafiur Rehman.

(13) BINDING MATERIALS FOR BOARDS: Work on the prepartion of carbohydrate-modified phenolic resins, suitable for the manufacture of chip board was completed. In view of the local production of urea, some compositions based on urea and formaldehyde have also been worked out for the purpose. It has been possible to prepare the urea resins in liquid form, which can be stored for a few months without deterioration or impairing its quality.

Project Associates: S. Siddiqui, Mohammad Aslam, Ashhad Mehdi and Ali Hussain.

The Japanese Ambassador to Pakistan in the Paints and Plastics Division of the Central Laboratories.

A view of the new building (Chemistry Block) of the Central Laboratories at Karachi.

Minister for National Science and President of Academy of Sciences, Indonesia in the Pharmacological Section of the Central Laboratories.

Prof. G. Hahn, Head of Chemical Division (second from the right), with distinguished visitor Mr. Z. A. Bhutto.

V

ABSTRACTS OF RESEARCH WORK CARRIED OUT AT P.C.S.I.R. REGIONAL LABORATORIES

EAST REGIONAL LABORATORIES

MEDICINAL PLANTS

(1) Caesalpinia bonducella (a) Bitter Constituents of Seeds: The work on the bitter constituent of Caesalpinia bonducella has been continued. (For previous work see P.C.S.I.R. Biennial Report, 1959 & 60, p. 91).

∝—Caesalpin, $C_{22}H_{32}O_8$, has been found to contain two acetoxyl groups, one carbonyl group and a furan ring, thus accounting for six of its eight oxygen atoms. Infrared spectra suggest that the remaining two oxygen fractions are hydroxyls, but these could not be acetylated—ν max. at 3572, 3448, 1727, 1714, 1506, 1259 and 973 cm^{-1}. β—Caesalpin $C_{18}H_{26}O_5$, has given a mono-acetyl derivative. Infrared spectra indicate two free hydroxyls in the acetyl compound, an ester carbonyl, and acetoxyl and a furan ring ν max. at 3546, 1700, 1501 and 872 cm^{-1}. These results agreed with the U.V. observations previously reported and accounted for all the oxygen atoms at β—caesalpin.

The third crystalline bitter, hydrolysed γ—Caesalpin, $C_{20}H_{30}O_6$, obtained from the amorphous bitter by alkaline hydrolysis has shown in its infrared spectra peaks for hydroxyl, the furan ring and a carbonyl group ν max. at 3412-3300 (broad band), 1502 and 875 cm^{-1}. The peak for the last is however very feeble, though the presence of the carbonyl group has been confirmed by preparing a DNP. The diacetate, $C_{24}H_{34}O_8$, was prepared and gave a peak of normal intensity for the carbonyl group. This suggested that the carbonyl group is not free but is in combination with a suitably situated hydroxyl group forming a hemiketal type of linkage thus, making its activity only potential.

As γ—caesalpin did not react with trityl chloride the absence of a primary hydroxyl group was indicated.

Periodate oxidation of ∝,β and γ caesalpin has been attempted. With ∝—caesalpin there is no reaction, but both β and γ—caesalpin consume exactly one mole of sodium periodate. This indicated that the two hydroxyls in ∝—caesalpin are not on adjacent carbon atoms. With β—caesalpin two of its three hydroxyls and with γ—caesalpin two of its

four hydroxyl are on adjacent carbon atoms. As β—caesalpin is also formed on hydrolysing ∝—caesalpin, the hydroxyl group generated in the former is on a carbon atom adjacent to one of the hydroxyl bearing carbon atoms.

Though γ—caesalpin itself consumes periodate, its diacetyl derivative does not; this shows that the adjacent hydroxyls of γ—caesalpin have been acetylated.

The periodate oxidation product of γ—caesalpin has been isolated, m.p. 219°C. Its infrared spectra showed the presence of aldehydic carbonyl group.

Potassium permanganate oxidation has given an acid m.p. 242-245°C, but this could not be obtained crystalline so far.

A number of experiments on selenium dehydrogenation of ∝,β and γ—caesalpin have been carried out but no definite hydrocarbon could yet be identified from the reaction products.

(b) Constituents of the Leaves: Further attempts made to crystallise the amorphous bitter constituent of *Caesalpinia bonducella* leaves, of which mention had been made in our previous report P.C.S.I.R. Biennial Report, 1959 & 60, p. 98), have been without success so far. On chromatographic separation a pure but amorphous bitter 119-120°, $C_{24}H_{24}O_8$, was obtained. Its infrared absorption spectrum indicated the presence of the hydroxyl, ester carbonyl, acetoxyl groups and the furan ring respectively in agreement with our previously reported chemical observations.

Infrared absorption spectrum of the sweet crystalline compound isolated from these leaves has shown, as expected, the presence of only hydroxyl and methoxyl groups. The compound had previously been shown by chemical methods to contain only these functional groups and has been characterised as pinitol (Caesalpinitol).

Further batches of the leaves have been extracted in the usual way to collect the bitter wax and pinitol.

The wax from the leaves has yielded on chromatographic separation, a crystalline product, m.p. 75-78°C.

A modified procedure for the isolation of pinitol from the leaves

has been attempted using water as solvent. The yield, however, was only 2%. The inorganic residue (6.3%) obtained during the working up of the aqueous extract is under investigation. Although this procedure of isolation of pinitol is apparently economical, the yield is much lower than in the chloroform alcohol method (5%).

A further modification—extraction first with petroleum ether, to dewax the leaves, followed by alcohol has given pinitol in 4% yield.

Attempts have been made to demethylate pinitol. With hydroiodic acid *d*-inositol, m.p. 235°C $[\alpha]_D^{27} + 68°$, was isolated in 90% yield. Hydrochloric acid in sealed tubes has also been successfully used as the demethylating agent and good yields of *d*-inositol have been obtained. Experiments are now under way to find the optimum conditions for this reaction.

Project Associates: Abdul Malek, M. E. Ali and M. Qudrat-i-Khuda.

(2) CASSIA FISTULA LINN: The fruit pulp of *Cassia fistula*, extracted with petroleum ether and methlated spirit in that order, has given a wax, sucrose and a yellow substance, m.p. 286-300°C which gave tests for anthraquinone glycoside. However, an extract from another batch of the fruit obtained by a modified procedure gave a yellow microcrystalline powder, m.p. 300-310°C along with the other two substances.

Project Associates: A. Khalique and Mrs. S. Nessa.

(3) POLYGONUM HYDROPIPER (BISHKANTHALI): Both the fresh and the dry plant materials were extracted with rectified spirit. The former after removal of solvent was extracted with water. This water extract gave positive tests for alkaloids both with Mayer's and modified Dragendorff's reagents.

The following crystalline substances have been isolated from the alcoholic extractives.

(*i*) m.p. 92-97°C.

(*ii*) Yellow needles, m.p. 300°C. The acetyl derivative of this compound has been prepared, m.p. 197-198°C.

(*iii*) m.p. 192°C, ν max. (KBr) 1789, 1642 cm^{-1}.

Other substances as yet in the crude state and in the process of purification are of :

(*iv*) m.p. 230-240°C,

(*v*) m.p. 226°C,

(*vi*) m.p. 86-92°C,

(*vii*) m.p. 82°C,

(*viii*) An essential oil.

Project Associates: A Khalique and H. M. Khuda (Miss).

(4) WITHANIA SOMNIFERA: *Withania somnifera* a medicinal plant has been reported to contain alkaloids. But the methods used for their isolation did not seem satisfactory and so a reinvestigation of this plant appeared desirable.

Roots and stem of the plant have been extracted with rectified spirit and the extractive therefrom, after removal of fatty matter and potassium chloride found in it, has been separated into basic and non-basic fractions. The first has yielded a mobile liquid as the base, and the second a crystalline compound, m.p. 280°C giving a violet colour with Liebermann-Burchard reagent. Both these two substances, the material remaining after their separation and the fatty matter are under examination.

Project Associates: M. E. Ali and M. Qudrat-i-Khuda.

(5) ASPARAGUS RACEMOSUS: A study has been undertaken to examine the active principles of *Asparagus racemosus*. A colourless substance, m.p. 83°C, was isolated from the alcoholic extract of the plant. It is under examination. A large portion of the residue from this alcoholic extract is soluble in water. This water soluble portion has been separated by paper chromatography. The separate fractions gave tests for glucose, fructose and sucrose. A thorough investigation of this water soluble portion for the isolation of sugars other than those mentioned above is in hand.

Project Associates: A. Khalique and M. Qudrat-i-Khuda.

(6) EUPATORIUM ODORATUM: Two substances, one melting at 80°C, and another at 26°C have been isolated from the leaves of

Eupatorium odoratum. Attempts are being made to isolate them in larger quantities for investigation of their structure.

Project Associates: M. Siddiqullah and M. Qudrat-i-Khuda.

(7) ANDROGRAPHIS PANICULATA: The work on *Andrographis paniculata* has been continued. (For previous work see, Biennial Report 1959 & 60, p. 95).

The petroleum ether extractive has given andrographone, m.p. 67-68°C and some new components.

(*i*) Paniculata wax B.

(*ii*) A steroidal compound m.p. 135°C.

The acetyl and benzoyl derivatives of this substance were prepared. The former melted at 126°C and the latter at 143°C. Thus the substance appears to be β—sitosterol.

(*iii*) Open chain ketone, named andrographone, $C_{32}H_{64}O$, m.p. 85°C; and

(*iv*) Three ∝—β unsaturated lactones.

(*a*) Named Homoandrographolide, $C_{22}H_{32}O_3$, m.p. 115°C., ν max. 3496, 1757, 1647 and 1079 cm^{-1}.

(*b*) m.p. 163-164°C ν max. 3325, 1755, 1290, 1265, 1038 and 905 cm^{-1}.

(*c*) m.p. 179°C, ν max. 3300, 1750, 1300, 1245 and 1040 cm^{-1}.

Both Paniculata waxes A (reported earlier) and B have been hydrolysed. The first gave an acid, m.p. 86°C, and an alcohol, m.p. 98°C. The second an acid, $C_{28}H_{56}O_2$, m.p. 77°C, and an alcohol, m.p. 75°C.

From the alcoholic extract a further crystalline substance, m.p. 113°C, has been isolated. It is ketonic in character.

The substance melting at 276°C reported earlier gave positive tests for sterols. Acid hydrolysis furnished a sterol, melting point 136°C,

and glucose. Hence it is a sterol glycoside. On saponification of the acetate, m.p. 161°C of this substance with strong alkali the same sterol was again obtained.

(8) EXAMINATION OF PANICOLIDE: Panicolide, the unsaturated lactone previously reported (loc. cit) has been found to contain one double bond, determined by the perbenzoic acid oxidation method.

Project Associates: K. M. Biswas, M. Qudrat-i-Khuda and Mir Amjad Ali.

(9) DATURA STRAMMONIUM: The investigation of Daturas has been continued (Biennial Report 1959 & 60., p. 99). The percentage of alkaloids in different parts of the plant growing in East Pakistan was found to be — Seeds 0.4%, Leaves 0.3%, and Roots 0.2%.

The crude alkaloids were separated by column chromatography. From the seeds, Scopolamine 0.11%, Atropine 0.08% and Novatropine, from the leaves, Scopolamine, and from the roots, Scopolamine 0.017%, and Atropine 0.01% have been obtained in this way.

From the neutral fraction of Datura seeds a colourless crystalline material, m.p. 275°C, has been isolated. It analysed for $C_{29}H_{48}O_2$ and its infrared spectrum showed that it contained the hydroxyl group ν max. at 3500, 2950, 1700, 1458, 1385, 1250, 1053 and 816 cm^{-1} $[\alpha]_D^{32}$ −50° (ethanol). Libermann Burchard test was positive, the compound was presumably a steroid. The presence of a double bond was indicated by its reaction with tetranitromethane. It is stable to acid hydrolysis.

Crude Datura alkaloids have also been separated by the countercurrent distribution technique. The following alkaloids were isolated:

Scopolamine, Alkaloid 'X' picrate, m.p. 210°C, and Alkaloid 'Y' picrate, m.p. 235-236°C.

Both the bases X and Y appear to be new. They are under examination.

From the non-basic portion of the concentrated alcoholic extract an acidic substance m.p. 200-204°C has been isolated. From the I.R. and U.V. spectra and its solubility in dilute alkalies the substance appears to

be an aromatic carboxylic acid derivative. It is being prepared in greater quantity for further investigation.

Further work on this plant is in progress.

Project Associates: M. Qudrat-i-Khuda, A. Khaleque (II) and N. Roy.

(10) CEPHALANDRA INDICA (TELAKUCHA): *Cephalandra indica*, a climbing herb of East Pakistan is reputed to have remarkable curative effects on diabetic patients and is also useful for skin eruptions and gonorrhoea. An investigation to isolate the active principles of the plant was, therefore, thought worthwhile.

EXTRACTION OF THE DRY WHOLE PLANT: Two waxes melting at 64°C and 79°C have been isolated from the petroleum ether extractive of the dry plant along with a sterol m.p. 133-135°C $[\alpha]_D^{28}$ –21.7 Liebermann-Burchard test was positve with the later. The infrared spectrum was almost identical with that of β—sitosterol and their mixed melting point was undepressed. The acetate of this sterol has been prepared. m.p. 130-135°C.

The residual plant material, left after extraction with petroleum ether, was extracted with alcohol. A crude alkaloidal fraction has been isolated from this alcoholic extractive in 0.02% yield. This has so far resisted all attempts at purification both through crystallisation and through preparation of derivatives.

On purification of the petroleum ether extractive from a new batch of the dry whole plant two substances, A and B, m.p. 66-68°C and 80.5-81.5°C, have been obtained. The first showed infrared peaks (KBr) at 3448, 2924, 2857, 1730, 1623, 1458, 1381, 1171, 735 and 710 cm^{-1}, and the second (KBr) at 3375, 2845, 1637, 1468, 1460, 1383, 1054, 727 and 718 cm^{-1}.

EXTRACTION OF THE DRY ROOTS: The dry roots were extracted with petroleum ether and alcohol successively.

From the alcoholic extract potassium nitrate and a low melting substance, m.p. 52-56°C, have been isolated.

EXTRACTION OF THE DRY LEAVES AND STEMS: The dry leaves and stems of the plant have been extracted with petroleum ether followed by alcohol.

The alcoholic extractive has yielded potassium nitrate and two compounds, C and D, m.p. 90-92°C and 100°C respectively. From the basic fraction of this alcoholic extractive two picrates, m.p. 200-207°C and 267.5-269.5°C have also been obtained.

EXTRACTION OF THE FRESH WHOLE PLANT: From the alcoholic extract of the fresh leaves and stems of the plant, the alkaloid referred to above has been obtained as the picrate, m.p. 214°C and the oxalate, m.p. 207°C. During the working up of another batch of the fresh plant, it has been found that there is more than one alkaloid in the plant. After purification by chromatography their picrates, picrolonates and hydrochlorides have been prepared. The last could not be crystallised. A new alkaloidal picrate m.p. 304°C was isolated during this series of experiments.

Further work is in progress.

Project Associates: M. Qudrat-i-Khuda, A. Khaleque (II) and M. A. Wahed Mia.

(11) TINOSPORA CORDIFOLIA: *Tinospora cordifolia,* a climbing shrub, is known from early days for its usefulness in chronic dysentery, rheumatism, dyspepsia and gonorrhoea. The plant growing in Central India has been investigated earlier. Some bitter principles and an alkaloid have been reported. The present examination of the plant growing in East Pakistan, has resulted in the isolation of several constituents including two bitter principles apparently different from those of previous workers.

EXTRACTION OF THE FRESH PLANT: The fresh plant was extracted with alcohol. From the extractive a basic fraction has been obtained in crude form in 0.03% yield. This could not be crystallised so far. However, it has given a picrate, m.p. 304-305°C. The non-basic fraction has yielded two bitters, 'A' and 'B'.

Bitter 'A', 236-238°C, has the molecular formula $C_{23}H_{26}O_8$ $[\alpha]_D^{33}$ −16° (in ethanol). It is stable to acid hydrolysis. I.R. peaks in chloroform: 3617 (hydroxyl), 1772 (lactone), 1740, 1290, 1140 and 912 cm^{-1}. 2,4-Dinitrophenylhydrazone of bitter 'A', m.p. 195-205 C has been prepared.

Bitter 'B', m.p. 176-177°C was obtained in 0.01% yield. It analysed for $C_{22}H_{26}O_7$ $[\alpha]_D^{33}$ 15.7 (in ethanol). I.R. peaks in chloroform: at 3600 (hydroxyl), 1750, 1030 and 913 Cm^{-1}.

EXTRACTION OF THE DRY MATERIAL: The dry plant material was extracted with petroleum ether and alcohol successively. From the petroleum ether extract of the dry plant, a wax ($C_{41}H_{82}O_2$: yield 1%) has been isolated (m.p. 69-71°C); it has characteristic I.R. peaks at 3025, 1725 and 1460 cm^{-1}.

Besides a sterol m.p. 145-146°C—I.R. peaks at 3140, 3020, 2610, 1506, 1383, 1302, 976, 937 and 919 cm^{-1} $[\alpha]_D^{24}$ —25.8, U.V. maximum at 205 mμ, has also been obtained.

From the alcoholic extract a colourless amorphous substance, m.p. 84-85°C, neutral in character has been isolated. It gave I.R. peaks (in $CHCl_3$) at 3625, 2910, 2860, 1700, 1600, 1463, 1410 and 1008 cm^{-1} and U.V. peak 202 mμ.

Further work is continuing.

Project Associates: M. Qudrat-i-Khuda, A. Khalique (II) and N. Roy.

(12) CINCHONA BARK ALKALOIDS: At present cinchona is cultivated in East Pakistan on an experimental basis. The cinchona plant (red bark, succiruba variety) obtained from the experimental farm of Chittagong Hill Tracts contains a high percentage of alkaloids.

Various methods of extraction have been attempted but the method of British Pharmacopoea (extraction with alcohol containing 2% ammonia after treating the dried, powdered bark with lead acetate) gave the most satisfactory results.

The alcoholic extractive was separated into basic and non-basic fractions. After purification by column chromatography and counter-current distribution, the following alkaloids have been obtained so far from the basic fraction.

Total Alkaloids 7.2%, Quinine 4.0%, Cinchonine 0.7%, Quinidine 0.11% and Concusconine in small amount.

Further work on the separation by counter-current distribution technique has resulted, apart from the isolation of the alkaloid, cuprine and a base, m.p. 60°C, presumably quinicine, in the isolation of two bases, X and Y, m.p. 143-144°C and 81°C, which appear new. Though the melting point of alkaloid 'X' agrees with that of concusconine the results of

analysis were different pointing to the molecular formula $C_{22}H_{28}O_2N_2$ for the new alkaloid. Infrared spectrum of X in KBr showed peaks at 3010, 1575, 1250, 1055, 935 and 796 cm^{-1}. For Y in chloroform the peaks were at 3205, 2930, 1620, 1590, 1496, 1450, 1424, 1370, 1320, 1135, 1090, 995, 944, 914 and 880 cm^{-1}. More work on the new alkaloids and on the isolation of quinidine (present in the dry bark to the extent of 0.5%) is in progress.

Project Associates: M. Qudrat-i-Khuda, A. Khaleque (II) and M. Aminuddin.

(13) PAEDERIA FOETIDA LINN. (GANDHABHADULIA): Gandhabhadulia is a climbing shrub widely distributed in India and East Pakistan. It is reported that an alkaloid is present in the plant. The juice of the leaves of this plant is said to be active against diarrhoea, dysentry and rheumatism.

EXTRACTION OF FRESH PLANT MATERIAL: The crushed fresh plant was extracted with alcohol and the extractive worked up in the usual way to separate the basic and the non-basic fractions. The basic fraction was obtained in 0.18% yield. As it could not be crystallised the picrate, m.p. 298-300 C, was prepared. From the non-basic fraction a crystalline material, m.p. 130-134 °C, has been obtained. The compound is soluble in petroleum ether, benzene, alcohol (hot) and chloroform. It has infrared peaks at 3500 (OH absorption) 2990, 1684, 1480, 1392, 1065 and 961 cm^{-1}. The spectrum was identical with that of an authentic sample of β —sitosterol.

EXTRACTION OF DRY PLANTS: From the petroleum ether extract of the powdered plant a substance, 'A' (m.p. 250-253 °C) has been obtained. It is soluble in petroleum ether, benzene, acetone and chloroform. The compound showed infrared peaks at 3580, 3000, 1725, 1480, 1400, 1185, 1005, 985 and 924 cm^{-1}. The U.V. spectrum showed end-absorption indicating the presence of double bonds.

Further work on the petroleum ether extract has resulted in the separation of the following substances.

Compound 'B' m.p. 269-270 °C	Infrared peaks at 2941, 1737, 1689, 1639, 1453, 1370, 1246, 1024, 978 and 883 cm^{-1}.
Compound 'C' m.p. 274-275 °C	Infrared peaks at 2941, 1700, 1458, 1445 and 923 cm^{-1}.

Compound 'O' m.p. 238-238.5 °C	Infrared peaks at 3448, 2941, 1712, 1453, 1388, 1106, 1070 and 1000 cm^{-1}.
Sterol, m.p. 134-135 °C	Infrared spectrum identical with β sitosterol.
Wax m.p. 60-62 °C	Infrared spectrum showed peaks at 1738, 1462, 1171 and 719 cm^{-1}.

The residue left after extraction with petroleum ether was extracted with alcohol. From the basic fraction of this alcoholic extractive two picrates, m.p. 131.5 °C and 145-148 °C have been prepared. The former has been decomposed to give the alkaloid X. It showed infrared maximum at 3333, 1724, 1605, 1445, 1381 and 1110 cm^{-1}. The acetyl derivative of this alkaloid has been prepared.

Investigations on the above compounds are continuing.

STEAM DISTILLATION OF RAW LEAVES OF PAEDERIA FOETIDA: Fresh leaves of *Paederia foetida* have a strong smell. It appeared desirable to isolate the odoriferous components and, therefore, the raw leaves were steam distilled. A small quantity of an oily liquid having strong smell was isolated.

Project Associates: M. Qudrat-i-Khuda, A. Khaleque (II) and B. B. Paul.

(14) TULSHI (OCIMUM GRATISSIMUM): (i) EXAMINATION OF THE STEMS: The stems of Tulshi were first extracted with petroleum ether and then with methylated spirit.

From the first a sterol, 'A' m.p. 140 °C $[\alpha]_D^{31} + 38.4°$ has been isolated.

From the second crystalline substances 'B', m.p. 260-270 °C, and 'C' have been obtained.

(ii) EXAMINATION OF THE LEAVES: The petroleum ether extract of the dried leaves has yielded the following substances:

(a) Needle-shaped crystals, 'D' m.p. 176 °C. This substance was readily soluble in alcohol and benzene. λ max. 269, 266.5, 259, 253.8, 249,

243. The acetyl derivative of this compound has been prepared, m.p. 180 °C.

(*b*) Waxy substance, 'E' m.p. 69-70 °C.

(*c*) An essential oil which has been distilled to yield three fractions.

(iii) Examination of the Flowers: The petroleum ether extract of the flowers has given a colourless crystalline substance, m.p. 216-218 °C readily soluble in alcohol and moderately in chloroform $[\alpha]_D + 59.6°$. A waxy material, m.p. 65 °C, has also been obtained.

Project Associates: A. Khaleque and J. R. Shaha.

(15) Pharmacognostic Study of Medicinal Plants: When the chemical investigation of a number of medicinal plants was taken in hand in the Natural Products Research Division of these Laboratories it was realised that a botanical study regarding the pharmacognosy of the plants should also be undertaken so that correct reference to the species of plants may be made in future and their correct diagnosis be obtainable.

Consequently detailed botanical study on the pharmacognosy of the species of medicinal plants being investigated in the laboratories has been started. This work assumes added importance due to the fact that no elaborate work on botanical pharmacognosy has been done in Pakistan till the present. So far the botanical pharmacognostic study of the species *Andrographia paniculata* (Kalmegh) has been completed, the result of which is being written as a scientific paper for publication elsewhere.

Similar work is being continued with other species of medicinal plants which are being chemically investigated in the East Regional Laboratories of P. C. S. I. R., Dacca. These are as follows:

1. *Ocimum gratissimum* L. (B. Ram Tulsi)—F. *Labiatae*.
2. *Corchorus capsularis* L.
3. *C. olitorious* L. (B. Pat)—F. *Tiliaceae*.
4. *Cephalandra indica* Schrad (B. Telakucha)—F. *Cucurbitaceae*.

5. *Tinospora tomentosa* Miers (B. Padmo-gulancha)—F. *Menispermaceae.*
6. *T. cordifolia* Mier (B. Gulancha)
7. *Datura fastuosa* L. (B. Kaladhutra
8. *D. stramonium* L. (B. Dhutra) } F. *Solanaceae.*
9. *Caesalpinia bonducella* Flem. (B. Nata Karanj)— F. *Leguminosae.*
10. *Portulaca tuberosa* Roxb (OB. Laniya)—F. *Portulacaceae.*
11. *Asparagus racemosus* Wild (B. Satamil)—F. *Biliaceae.*
12. *Saccharum officinarum* L. (B. Akh)—F. *Gramineae.*
13. *Engenia Jambolana* Lamk. (B. Kalajam)—F. *Myrtaceae.*
14. *Acorus calamus* L. (B. Bach)—F. *Orontiaceae.*
15. *Hygrophila spinosa* T. (B. Talmakhana)—F. *Acanthaceae.*
16. *Andropogon citratus* Dec. (Lemongrass)—F. *Gramineae.*
17. *Eupatorium odoratum* Linn. (B. Asumlata)—F. *Compositae.*
18. *Zanthoxylum budrunga* Wall (B. Badrang)—F. *Rutaceae.*
19. *Paederia foetida* Linn. (B. Gandhabhadulia)—F. *Rubiaceae.*

Project Associates: Asheque Ahmed and S. Hedayetullah.

(16) Collection of Medicinal Plants, their Identification and Preparation of Herbarium Sheets: A complete survey of medicinal plants of East Pakistan is contemplated. In pursuance there of Herbarium sheets and coloured plates of the medicinal plants have been systematically arranged according to Bentham and Hooker's system.

The coloured plates were only artistic drawings of the plants of little value for reference as *iconis* of botanical species; therefore drawings of the parts of identificational importance have been prepared of 24 coloured plates so far.

Herbarium sheets of more than 400 species have been prepared.

Above one hundred species of medicinal plants have been collected and identified during 1962.

Project Associates: S. Hedayetullah and Din Muhammad.

(17) CULTURE OF MEDICINAL PLANTS IN THE GARDENS OF THE LABORATORIES: The seeds of twenty species of medicinal and fibre yielding plants have been sown in the laboratory grounds for observation of the growth of the plants and other studies. The following plants are growing quite well.

(*i*) Somraj—*Veronia anthelmintica.*

(*ii*) Ishurmul—*Aristoochia indica.*

(*iii*) Raktomug—*Phaseoles rubra.*

(*iv*) Moghania (*Flemengia*).

Besides medicinal plants, vegetables for supply to the Food and Fruit Technology and Nutrition Sections have also been grown.

(18) SCOPARIA DULCIS: CONSTITUENTS OF THE ROOTS: Semi-dried roots of the plant *Scoparia dulcis* were extracted with alcohol. The alcoholic extractive has yielded

(i) mannitol, and (ii) a crystalline neutral substance, m.p. 288-290 °C.

This last substance decolourises bromine. It gives an acetate, m.p. 287 °C. It is under investigation.

The root left after extraction with alcohol was further extracted with 75% alcohol in water. The extractive, thus, obtained is under examination.

Photo-offset printing machine recently installed in PANSDOC.

A Section of the Fuel Research Division, East Regional Laboratories, Dacca.

Governor G. Farooque (third from left) in the East Regional Laboratories, with Dr. M. Qudrat-i-Khuda, Director, East Regional Laboratories and Dr. S. Hedayetullah.

Spacious corridor of a research building of the East Regional Laboratories.

NATURAL PRODUCTS

(1) Jute Seed Proteins: In continuation of the work on jute seeds (P.C.S.I.R. Biennial Report 1959 and 1960 p. 101) referred to PCSIR by the Pakistan Central Jute Committee, a water soluble protein fraction has been obtained from Jute seeds in a yield of about 20%. It has been under examination for sometime now to evaluate it for different purposes including edible ones.

After extraction with water the seed residue was successively extracted with acid and alkali. The results are tabulated below:

Extraction medium	Yield of protein	Nitrogen content of the protein
1. Water	20%	5%
2. Acid	3.5%	3.5%
3. Alkali	3%	8%

The water-soluble protein has been further examined.

(i) Moisture content (Abdarhalden method) — 13.1%

(ii) Ash content — 20%

Qualitative analysis of the ash showed the presence of $Fe^{3}+$, $Ca^{2}+$, $K+$, $Na+$, PO_4^{3-} and SiO_2 (in traces)

(iii) Phosphorous content — 5.2%

(iv) Tests for protein—Ninhydrin, Biuret Hopkins—Cole Glyoxylic acid positive

(v) Test for carbohydrates—Molisch's positive, Fehling's negative.

This protein fraction has been subjected to acid hydrolysis. The hydrolysis products have shown the presence of reducing sugars and of Fe^{3+}, Ca^{2+}, K^{+}, Na^{+} and PO_4^{3-}.

Project Associates: A. Khalique, D. C. Das, L. N. Dutta and M. Qudrat-i-Khuda.

OTHER CONSTITUENTS OF JUTE SEEDS: The work on the bitter and other constituents of jute seeds has been continued and has resulted in the isolation of the two glycosides A and B.

Glycoside A, m.p. 190°, $[\alpha]_D^{30} \pm 0.8 + 0.5°$, γ max (KBr) 3597, 1740, 1720, 1645, 1449, 1393 cm^{-1} has been hydrolysed to give strophanthidin and the sugars identified as glucose, arabinose and a third under examination. The acetate of this glycoside has been prepared, m.p. 230-232°.

Glycoside B., m.p. 137-140°, $[\alpha]_D^{30} - 9.6°$, γ max (KBr) 3413, 1718, 1626, 1389 cm^{-1} has also been hydrolysed. strophanthidin and the sugars raffinose, glucose, fructose and galactose have been identified in the products of hydrolysis. The glycoside gave an acetate m.p. 132—136°C.

In continuation of the work on the isolation of useful constituents of jute seeds like strophanthidin and raffinose on which a patent has already been taken, 100 kg of Jute seed powder has been processed to give strophanthidin 0.5 kg, raffinose 4 kg. and jute oil 15 kg.

Project Associates: A. Khaleque and D. C. Das.

JUTE LEAF: The work on Jute leaf has been continued (Biennial Report 1959 & 60, p. 102). So far four bitter glycosides have been isolated from it together with a sterol.

(i) Bitter I. m.p. 168-170°, $[\alpha]_D^{30} -22.6°$, λ max 212.5, γ max (KBr) 3472, 3165, 1779, 1742, 1645, 1449, 1377, 1155, 1077, 1033, 1025 cm^{-1}.

(ii) Bitter II. m.p. 258-260°, $[\alpha]_D^{30} + 42.8°$, λ max. 212.5, γ max. (KBr) 3509, 2021, 1704, 1658, 1460, 1387, 1056, 1036, 961, 922, cm^{-1}.

(iii) Bitter III. m.p. 202-204°, $[\alpha]_D^{30} - 20.7°$, λ max. 212.5, γ max.

(KBr) 3521, 3225, 1773, 1748, 1645, 1453, 1381, 1312, 1157, 1073, 1033, 1029 cm^{-1}.

(iv) Bitter IV. m.p. 190-192°. The acetate derivative of this substance has been prepared, m.p. 202-204°, $[\alpha]_D^{25} - 26°$.

(v) Sterol, m.p. 145-146° $[\alpha]_D^{21} - 37°$, γ max. (KBr) 3521, 1603, 1454, 1374 cm^{-1}.

(vi) Substance, m.p. 75°C

(vii) Amorphous substance m.p. 275-280°C

Project Associates: A. Khaleque, D. C. Das, Fazlul Huq and M. Qudrat-i-Khuda.

2. Study of the Stero-chemical Aspects of Camphoric Acid Esters: It was intended to study the stero-chemical aspects of camphoric acid esters from their electrolytic decomposition products. The two esters, ortho-methyl hydrogen camphorate and allomethyl hydrogen camphorate have been prepared in quantity, starting from *d*-camphoric acid.

On electrolysis of the ortho ester a light yellow ether soluble liquid was obtained to the extent of 30% (on the wt. of the ester subjected to electrolysis) and in case of the allo-ester the yield of similar product (yellow coloured ether soluble substance) was 23% of the ester used. The products of electrolysis gave positive hydroxamic acid test for esters. They were purified through fractional distillation in vacuo the former giving, as the main fraction, a liquid boiling at 105-120°C/10 mm and the latter one 100-115°C/10 mm.

As the presence of ketones in both products was expected (they had a very characteristic odour reminiscent of some ketonic compounds) attempts were made to prepare the semicarbazones. The allo-ester product gave the derivative m.p. 217°C, but all attempts to prepare the semicarbazone of the ortho-ester product failed.

The two substances b.p. 105-120°C/10 mm and b.p. 100-115/10 mm. have been hydrolysed with alcoholic potash and the hydrolysed material purified by chromatography. The first has given a crystalline acidic substance m.p. 125°C and the second one m.p. 223°C.

Work on the isolation of material from other fractions of the chromatograph is in hand.

Project Associates: M. Qudrat-i-Khuda and A. Sattar.

(3) Chemical Investigation of Goran Wood: Goran wood has been extracted with petroleum ether, alcohol (95%) and water. From the petroleum ether extract a glassy mass was left as residue. The two latter solvents gave brown solid residues as extractives. The tannin from the water extract was hydrolysed by sulphuric acid when a red precipitate was obtained. This is under examination. The aqueous filtrate gave positive tests for reducing sugars. Arabinose and sucrose have been found present in it.

Studies on Some Essential Oils: (i) Pan (Pipet betle): Pan leaves and their stalks have been separately steam distilled. In both cases, oils having the typical odour of pan leaves were obtained. The water layer was tested for alkaloids but these were found absent.

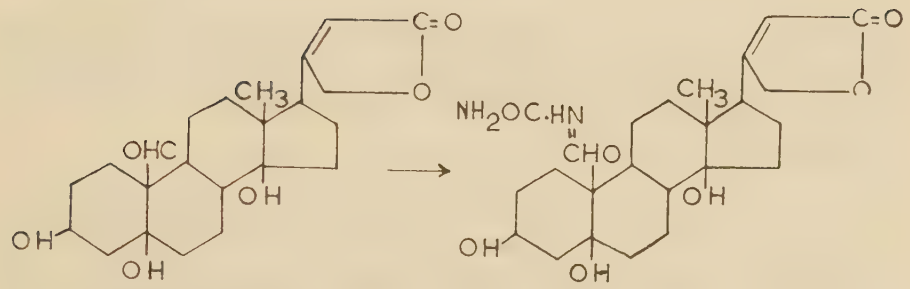
(ii) Inflorescence of the Mango Tree: Fresh flowers from the local mango trees were steam distilled when an essential oil having their odour was obtained.

(iii) Camphor and Camphor Oil from Cinnamonium camphora Nees: Steam distillation of the leaves, stems and roots of the local camphor tree gave camphor mixed with camphor oil. Camphor has been separated there-from.

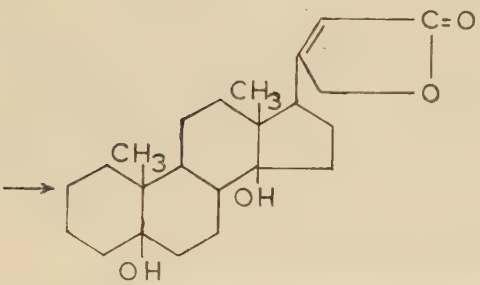
The investigation is in progress.

Project Associates: M. Nurul Huq and M. Qudrat-i-Khuda.

(4) Synthesis of Cortisone: An attempt is being made to synthesize cortisone from strophanthidin. Periploganin an intermediate in the scheme, has been prepared from the semicarbazone of the latter so far.



Strophanthidin



Periploganin

Project Associates: A. Khaleque and D. C. Das.

(5) PINEAPPLE LEAF FIBRE: Pineapples are grown on substantial acreage in the districts of Sylhet, Dacca, Tippera, Chittagong and Chittagong Hill Tracts. So long the pineapples were being consumed as fresh fruits. With the marketing possibility of canned pineapples, a few canning factories are already in production and more are in the offing. The area under pineapples is also increasing considerably.

A pineapple plant dies after bearing fruit once. Consequently after the harvest of the fruit, the leaves of the plant go waste. A process of

extraction of fibres from the leaves and their use has been developed in these laboratories.

Project Associates: S. Hedayetullah and Asheque.

(6) Cocos nucifera "Coconut": The work on coconut has been continued. It appears that quite a good amount of coconut dust is obtained as by-product during the beating of the husk (epicarp and mesocarp) to separate the fibres therefrom.

Histological investigations have been carried out for proper understanding of the relation between coir and the dust as they exist in the mesocarp of a coconut fruit from the very young stage to the time when coconut is husked to get the kernel. Initially the husk of mature coconut has been studied. Thin transverse and longitudinal sections were cut from a portion of mesocarp and examined under microscope. The mesocarp has been found to be composed of ground tissues in which the coir fibre strands are imbedded. The ground tissue consists of two kinds of loosely arranged parenchymatous cells; in shape the cells are curved, sausage like with rounded ends. The only difference is in their contents—one has brownish contents and the other colourless. The wall of these cells is rather thin. Microchemical tests have revealed that the ground tissue cells of the coconut husk are analogous to corky cells. This opens the possibility of exploring coconut dust for manufacture of cork sheets and boards.

Further work in this direction is in hand.

Project Associates: Asheque and S. Hedayetullah.

(7) Jute Sticks: (a) Pulping Studies: The work on jute sticks—the waste product of jute 7,00,00,000 maunds of which are obtainable every year has been continued. Investigations have shown that three important products: cellulose, furfural and lignin can be obtained in a single operation. Attention is at the moment concentrated on the cellulose fraction, the aim being to standardize the single stage pulping and bleaching process (alkaline nitrobenzene process) for jute stick powder. Accordingly a method has been developed, and considerable progress achieved in obtaining fairly high class paper, acetate sheet (transparent), and very strong paper suitable for making multi-walled paper bags. Further studies with a view to final standardization of the process for taking it to the Pilot Plant stage are in progress.

A second grade pulp has also been developed from jute stick. It seems very promising for the production of hardboard corrugated sheets, paper cartons and the like. The process for making hard boards has been developed. Details of it are being worked out.

(b) COMPOSITIONAL STUDIES: It has been felt necessary to investigate the composition of jute sticks so as to ascertain their value in the light of technical uses proposed as a result of research in this section.

The study concerns the solubility in water and alcohol-benzene, the pentosans and the hemicelluloses, the lignin and the α, β and γ 'kenat' cellulose contents.

Two other fibre producing plants of East Pakistan 'mesta' and 'kenat' are also under study with regard to their compositions.

(c) STUDIES ON THE LIGNIN COMPONENT: In the alkaline nitrobenzene process mentioned above, the lignin of the jute stick gets degraded to different extents depending on the drasticity of pulping. This study concerns the evaluation of these degraded by-products. Pure vanillin and syringaldehyde have been separated therefrom. Attempts are being made to modify the procedure for the large scale separation of these two industrially important chemicals.

Project Associates: M. Siddiqullah, Mujibur Rahman and M. Qudrat-i-Khuda.

(8) JUTE THREAD WASTE: Jute thread waste has been converted into pulp consisting of small fibres of average length 2.3 mm. and average diameter 7.9 microns. Such fibres are present in the pulp to the extent of 95%.

The degradation of jute thread waste into fibres of the same length as the long fibres from soft wood promises many uses for this material.

(9) SYNTHESIS OF NYLON INGREDIENTS FROM FURFURAL: 1:4—Dichlorobutane and 1:4 dicyanobutane have been produced in quantities from tetrahydrofuran. Adipic acid is now being prepared from the dicyanobutane.

Project Associates: M. Siddiqullah and S. A. Majid.

INDUSTRIAL WASTES

(1) Recovery of Sugar from the Sugar Factory Molasses: In the last report (P.C.S.I.R. Biennial Report 1959 & 60, p. 107) it was mentioned that a process has been developed in our laboratories giving about cent per cent recovery of sugar from molasses. The process has been repeated several times with consistent results. Efforts are now being made for trying out the process on the pilot plant scale.

Project Associates: E. Ali and M. Qudrat-i-Khuda.

(2) Waste Wood from Match Industry: In East Pakistan there are more than 15 Match Factories, and a majority of these are concentrated in Dacca and Chittagong. The annual consumption of wood in these factories is to the tune of 11,11,775 cu.ft. and out of this 3,71,509 cu.ft. is waste material for which at present there is no use except as a very inferior type of fuel. With a view to improve utilization of this product some samples of wood waste were obtained from a Match Factory and subjected to pulping study in the same single stage process as applied to jute sticks (vide supra). Hard boards have been produced from the pulp suitable for making paper board match sticks.

Project Associates: M. Siddiqullah and S. Hedayetullah.

(3) Tea Waste from Tea Industry: The Tea Industry of East Pakistan produces a substantial quantity of tea waste which at present is mostly exported to Japan where they manufacture caffeine out of it. In our previous report (Quinquennial Report 1953-1958, p. 93) it was mentioned that about 2% of caffeine could be isolated in our laboratories from samples of tea waste. Deriving encouragement from our study as also from the report that it contains, in addition to caffeine and theobromine, some vitamin P like compounds in the tea tannins we have continued our work on tea wastes; the highest tannin content found by us so far is 11%. The studies with various samples are being continued to get an overall idea of the constituents in our tea waste.

A detail of specifications for a caffeine extraction plant has been prepared in response to the request of the Pakistan Tea Board.

Project Associates: E. Ali and Miss Jinnat Ara.

FUEL RESEARCH

(1) Faridpur Peat: The Geological Survey reports a total deposit of 1000 million tons of peat. The ash content, which was earlier found to vary from 4 to 30 per cent, was regarded as the greatest bar against economic exploitation.

A sample of raw peat containing 24.52% ash was washed. The ash content came down to as low as 14%. On analysis the ash from raw peat showed SiO_2, 47.87; Fe_2O_3, 6.12; Al_2O_3, 13.07; MgO, 4.42%.

The low temperature carbonisation of peat at 300°C gave gas 12%, coke 62%, pyridine, quinoline etc., 0.04%, phenol 0.5%, neutral constituents 0.2%, tar 1.8% and ammonia 0.94%.

Fifteen different samples of peat were also received from P.I.D.C. Their ash contents varied from 4 to 38.9%.

The moisture content comes down to 10% on sun drying. It is very encouraging that the raw sun-dried peat has been found to give a very hard pellet. The dirtiness due to smoke soot is expected to go on briquetting peat and carbonizing it at 250-350°C. In this way, using the proper samples of Faridpur peat containing low ash, it is possible to get a dry, smokeless and clear fuel with reasonably high calorific value.

Further work has been done on the carbonisation of peat.

Sample carbonised at	Yield of coke	Calorific value B. T. U./lb. in the range of
250°C	68%	10600
360°C	62%	11,000
400°C	51%	—
Raw	—	8000

From the results it appeared that carbonisation at 250°C was quite satisfactory as the quality of coke obtained was about the same as that obtained at 360°C.

The behaviour on burning of carbonised peat has been compared with that of ordinary coal. The results are very satisfactory.

The gas formed on carbonisation of peat at 350 and 200°C have been analysed.

Gas obtained at 350°C	*Percentage*
Hydrogen sulphide and Carbon dioxide	53.7
Unsaturated hydrocarbons	1.6
Oxygen	1.7
Carbon monoxide	9.0
Hydrogen	12.9
Ethane	0.3
Methane	9.8
Nitrogen	11.0
	100.0

Gas obtained at 200°C	*Percentage*
Hydrogen sulphide and Carbon dioxide	37.0
Unsaturated hydrocarbons	0.9
Oxygen	8.2
Carbon monoxide	7.2
Hydrogen	7.5
Ethane	0.1
Methane	7.8
Nitrogen	31.3
	100.0

Project Associates: T. Ahmed and S. A. Samad.

(2) Fire Wood Distillation Products: The East Pakistan Forest Department sells nearly half a million tons of fire wood annually in Dacca city. The fact that wood can be used as a source of various useful chemicals, led us to distill it on a laboratory scale. Goran, Sundari and Gajari woods have been dry distilled so far.

On an average they give:

Charcoal 34%

Acetone and methanol	0.75%
Acetic acid	1.5%
Phenols	0.8%
Combustible gas	4.0%
Tar	15.0%

Charcoal as a fuel is a far better substitute for wood. Moreover, attempts are being made to activate it by the treatment of heat, steam and chemicals.

Work has been continued on the destructive distillation of these three varieties of wood in order to collect more material for further work.

The average of this processing is shown in Table 1.

Table 1

Name of Wood	Pyroligneous Liquor Wt.%	Settled Tar Wt%	Pyroligneous Acid Soluble for Wt%	Total Tar Wt%	Charcoal Wt%	Gas Wt%	Loss Wt%
Goran	40.0	4.5	2.5	7.0	33.5	14.0	5.5
Sundari	28.5	5.8	2.5	8.3	34.6	20.0	8.5
Gajari	35.3	5.6	2.5	8.1	34.0	16.7	5.9

The tar was separated into acidic and basic components. The average results are shown in Table 2 below:

Table 2

Name of Wood	Total Tar Wt%	Phenols Wt%	Basic Components Wt%	Fatty Acids Wt%	Polyphenol Wt%
Goran	7.0	0.80	0.12	0.24	1.7
Sundari	8.3	0.57	0.06	0.10	1.4
Gajari	8.1	0.59	0.10	0.07	1.3

The phenolic bodies of the tar have been subjected to purification by fractional distillation. Eight fractions have been collected. Their infrared spectra exhibited peaks characteristic of phenolic hydroxy groups. However, efforts to prepare the derivatives like benzoates, nitrobenzoates, 3,5 dinitrobenzoates and sulphonates have not met with success so far. Only the aryloxyacetic derivatives could be made. Two of these from the first and second fraction have been prepared so far, m.p. 109° C and 78° C, respectively. Alkoxyl groups were also present in both these fractions.

The volatile components of the pyroligneous liquor are also under investigation. By fractionation three products b.p. 57-60° C, 61-70° C and 70-85° C, have been obtained. Further examination of these fractions is in hand.

The acidic components of the pyroligneous liquor are being estimated. In the crude liquor obtained along with tar from Goran wood, the percentage of formic acid was found to be 0.6 (calculated on the weight of the wood).

The polyphenols obtained from Goran wood did not melt even at 300° C. They are slightly soluble in acetone, rectified spirit, ether and chloroform but not in benzene, petroleum ether and carbon tetrachloride. Further work on these substances is continuing.

Project Associates: A. Rahman and S. A. Samad.

(3) Active Charcoal from Goran Wood: Three procedures were used for activation of the charcoal obtained on destructive distillation of Goran wood.

(*a*) Treatment with magnesia and megnesium chloride

(*b*) Treatment with zinc chloride

(*c*) Heat treatment

All the samples so obtained were tested for their adsorbing properties, activated charcoal supplied by Messrs. E. Merck being used as standard for comparison purposes. Their adsorptive ability for potassium permanganate, iodine and methylene blue were estimated. Of the three methods of processing for activation heat treatment (for 17 hours at 800°C)

was found to be very satisfactory. The results with it are summarised below:

Adsorption capacity of charcoal	Potassium permanganate mg.	Iodine mg.	Methylene blue mg.
Goran wood heat treated	925	176	212
Activated charcoal E. Merck	703	181	187

A study of the economics of the process was very encouraging. The cost per lb (including packing charges) of the finished charcoal for a 1 ton per hour plant was estimated to be 51 paisas which compares very favourably with Rs. 4.00 to 5.00 for the imported stuff.

(4) Studies on Sylhet Gas: (a) As Source of Formaldehyde: Natural gas with methane as the prevailing constituent can be oxidised on a large scale to provide formaldehyde, acetone and some other products which are intermediates in the preparation of the useful chemicals. As the Sylhet gas is of such a composition attempts have been made to prepare the above chemicals from it.

The results of experiments carried out so far are not very satisfactory, the maximum yield of formaldehyde being only 12.3%.

Further work is continuing.

(b) Two Condensates of the Gas: The natural gas produced at Sylhet is the source of two condensates occuring in the gas in the vapour form wherefrom it is stripped off by fractional condensation. The products are, thus, practically clean water white and do not require further processing. The condensate of the kerosene type is of great value as aviation fuel and is actually used by PIA for their Jet aircrafts. 250,000 gallons of the condensates were produced in 1961.

This condensate is recovered in two fractions (light and heavy stuffs). They are being examined in these laboratories for their possible industrial uses.

Both the light and heavy products were subjected to standard boiling range distillation. The boiling ranges were 45 to 128°C for the former and 80 to 240°C for the latter.

The residual fraction from the heavy stuff boiling from about 170°C to 230°C-250°C was interesting from the standpoint of cracking with a view to the production of unsaturated hydrocarbons mainly olefins, useful for plastics and synthetic fibres. The preliminary experiments have given very encouraging results, the yield of olefins in the gases obtained being in the neighbourhood of 30%. The bromides of the olefins have been prepared. A substantial quantity of the dibromides of ethylene and propylene have been isolated from them by fractional distillation.

Further experiments on cracking and identification of the gases generated are being conducted.

Miscellaneous:

The following new apparatus have been installed.

(i) ORSAT—Gas analysis apparatus

(ii) Gas calorimeter system, Reinecke-Bochum

(iii) Kattwinkel—Benzene recovery equipment

(iv) One volatile-matter-in-coal determination oven.

Analysis of Sylhet Gas has given the following results:

	Percentage
Hydrogen sulphide and Carbon dioxide	0.4
Unsaturated hydrocarbons	0.5
Oxygen	0.2
Carbon monoxide	0.2
Hydrogen	3.6
Methane and Ethane	91.2
Nitrogen	3.9
	100.00

CERAMICS, MINERALS AND GLASS

Ceramics Research

(1) Examination of Physico-chemical Properties of Different East Pakistan Clays: (a) Infrared Absorption Analysis: The mineralogical composition of a clay determines to a great extent its physico-chemical properties and its suitability for uses in industries. Infrared absorption spectroscopy is, at present, a well developed technique for identification of clay minerals. We have employed this method for the mineralogical study of Bijaipur clay and Mirpur (red and black) clay.

The three absorption spectra have identical absorption peaks as kaolinite, and differ only in their intensities. The three clay samples, therefore contain the same kaolinite clay mineral. Whilst Bijaipur clay contains the least amount of impurities Mirpur clays (red and black varieties) contain larger proportions of them.

Project Associates: M. A. Biswas, A. K. Basak and M. Qudrat-i-Khuda.

(b) Base-exchange Property of Bijaipur Clay, Mirpur Clay (Red and Black Varieties) and Dacca Silt: In water medium, the clay particles behave as negatively charged polyvalent colloids. Electrical neutrality of these charged particles is maintained by a swarm of cations, which are loosely bound and are easily exchangeable with other cations. This property is known as the base-exchange capacity of a clay and it depends chiefly on the content and type of clay minerals present in a clay. Such exchangeable cations have immense influence over many physical properties (plasticity, shrinkage, drying property etc.) of a clay. A knowledge of the base-exchange property of a clay, therefore, gives us its mineral constituent and hence its working properties, and therefore we have undertaken a study of the base-exchange capacity of the above mentioned clays.

Clay samples have been prepared by washing and elutriation and their base-exchange capacity has been determined by three methods. The determined capacity for Bijaipur clay is about 4 and those for Mirpur (red), Mirpur (black) and Dacca silt are about 11.14 and 19 milli-equivalents per 100 gms. of clay respectively. The low base-exchange capacity

of the Bijaipur clay indicates that the chief clay mineral in it is kaolinite. Mirpur clays (red and black) are also composed of kaolinite but they contain larger proportions of impurities due to which slightly higher values have been obtained. Dacca silt contains kaolinite to a small extent together with other minerals as constituents.

Project Associates: M. A. Biswas, A. K. Basak and M. Qudrat-i-Khuda.

(c) Physical Characteristics and Beneficiation: Plasticity, colour (fired and unfired), specific gravity, water of plasticity, porosity, shrinkage etc., the chief ceramic properties of beneficiated and unbeneficiated samples of Bijaipur clay and Mirpur clay (red, back and yellow) have been studied with a view to estimate their importance as ceramic raw materials. In the case of Bijaipur clay washing and elutriation increase the plasticity from 20.6% to 30.92%, but decrease the specific gravity from 2.668 to 2.590 due to the removal of the heavy and coarse sand particles. The drying shrinkage of the elutriated clay (5.1%) was found to be less than that of the washed clay (8.0%). On the whole elutriation yielded a much better sample than simple washing.

The particle-size distribution of the washed clay has also been determined. According to the standard specifications for the manufacture of fine porcelain at least 20% of the clay should be finer than one micron. About 39% of the washed Bijaipur clay sample was found to have an effective particle diameter of less than 0.8 microns, indicating the possibility of its use in fine porcelain.

The firing properties for example, porosity, firing shrinkage, bulk density, apparent specific gravity, absorption and degree of vitrification of the raw and beneficiated samples of Bijaipur clay have been investigated at different temperatures upto 1000°C. Both, the washed and the elutriated clays, show satisfactory firing behaviour upto this temperature. Although the raw clay does not exhibit any appreciable change in firing properties, the washed and elutriated samples showed a gradual decrease in porosity with increasing temperature from 58.82% at 800°C to 40.13% at 1000°C. From these observations it appeared that for complete vitrification a firing temperature much higher than 1000°C will be necessary. Studies at 1300°C are being conducted.

Similar studies are also being conducted with Mirpur clays, red, black and yellow varieties. The firing properties upto 800°C have been studied so far.

Clay residue obtained after treatment of Mirpur red clay by hydrochloric acid is found to have almost identical properties with those of fire-clay and can be used for making different white wares. The iron free clay is highly plastic and has good firing properties with low shrinkage. The white clay has been obtained in the H-form having a water of plasticity of 48.11%. The infrared absorption spectra indicated that the acid treatment did not bring about any change in the clay mineral (kaolinite).

Project Associates: M. A. Biswas and M. Qudrat-i-Khuda.

(d) Extraction of Alumina from: (i) Bijaipur Clay: Beneficiated Bijaipur clay containing about 30% alumina, 0.34% iron oxide and 57% silica was calcined at 720°C and leached with 10 N sulphuric acid solution (optimum concentration) for three hours (optimum time). Complete extraction of iron together with 85% extraction of alumina has been obtained under these conditions. Recovery of pure aluminium sulphate from the leached liquor by crystallisation and by other physico-chemical methods is under study. It has been possible to recover aluminium sulphate as potash alum from the leached solution with the addition of K_2CO_3 or K_2SO_4. The process is now being investigated on a semi-pilot plant scale for evaluating its economics.

Project Associates: M. A. Biswas, A. Rouf and M. Qudrat-i-Khuda.

(ii) Mirpur Red Clay: This clay contains a considerable quantity of iron as an impurity and as such is used for manufacture of brick, tiles, clay pipes etc. Hydrochloric acid solution has been employed for the treatment of this clay with a primary view to remove the iron completely from it and to get an improved ceramic raw material. Optimum conditions for the removal of iron have been established and those for the extraction of alumina from the treated clay are under investigation. Acid concentration has been found to be the most important variable. Preliminary investigations have indicated that the excess hydrochloric acid in the leach solution is completely recoverable. The hydrated ferric chloride recovered from it can under good oxidising conditions be directly converted to ferric oxide (red pigment) and hydrochloric acid. The optimum conditions for this process are under study.

The industrial feasibility of the process including its economics on a semi-pilot plant scale is under study. In the above process however, 1.3% of iron remained unextracted. It appears that this iron is present in the

clay in a chemically bound state. Studies on its complete removal are being continued.

Studies on the extraction of alumina from Mirpur red clay by hydrochloric acid have made considerable progress. Under optimum conditions about 52% of the total alumina in the uncalcined clay is extractable in this way. The calcined clay on leaching with the acid gave out all its iron and most of its aluminium contents. A method of isolation of hydrated aluminium trichloride crystals from the mixture of chlorides in the leach solution has been developed. The industrial feasibility of the process is under study. The decomposition of aluminium chloride into alumina and hydrochloric acid is also under investigation.

Project Associates: M. A. Biswas, S. Jahangir Ahmed and M. Qudrat-i-Khuda.

(e) Mirpur Black Clay: The beneficiated clay contains 26.5% alumina, 2.5% iron oxide and 48.8% silica, with loss on ignition upto 21.5%. The extraction of alumina from this clay has been studied by the action of sodium hydrogen sulphate at elevated temperatures. The calcined mass was digested with water acidified with N/2 sulphuric acid and the alumina content together with iron was estimated in the leach liquor. Complete extraction of iron together with 89% extraction of alumina has been obtained from the calcination product. Optimum conditions for this process have also been determined. Further work will be taken up on the semi-pilot plant scale.

Project Associates: M. A. Biswas, Mrs. S.N. Nabi and M. Qudrat-i-Khuda.

Mineral Research

(2) Studies on Pakistani Chromite Ore: It has been found that sodium bisulphate is a better fluxing agent for chromite than potassium hydrogen sulphate mixture. A method of analysis of chromite by fusion with the former salt has been developed. Different methods including ion-exchange resin technique of preparing basic chromium sulphate from the solution of the fusion product are being studied. Isolation of chromium sulphate from the mixed sulphates of iron, aluminium, magnesium, calcium and chromium is also under study by both ion-exchange and fractional crystallisation. Preliminary work by the first method has shown that

preferential absorption of chromium to the extent of 56% was possible under optimum acid concentration. Further work is continuing.

Project Associates: M. A. Biswas, M. A. Haroon and M. Qudrat-i-Khuda.

Glass Research

(3) Examination of Different Sands: (a) Sylhet Sand: A sample of sand obtained from the Sylhet deposits was subjected to the action of hydrochloric acid gas at elevated temperatures. The product was completely free of impurities. Another sample of this sand collected from a different source is now under study. Preliminary investigations have indicated that the technique can be applied to this sample as well. A detailed study of the optimum conditions of the process are now being conducted.

Project Associates: Siddique Ahmed and M. A. Biswas.

(b) Kalia Koir Sand: This river sand has been analysed (SiO_2, 83.35%; Fe_2O_3, 4.15%; Al_2O_3, 9.90%; loss on ignition, 1.25%; and TiO_2 traces). The different fractions of the sand obtained on sieving have been separately examined for their impurity contents. Both washing and hydrochloric acid treatment failed to improve its quality to any appreciable extent.

Project Associates: N. K. Das and M. A. Biswas.

(c) Viti Sand: This river sand has also been analysed and found to contain SiO_2 74.54%; Fe_2O_3, 3.98%; Al_2O_3, 14.90%; CaO, 4.12%; ignition loss, 0.99% and TiO_2, traces. Washing has not improved the quality of this sand to any appreciable extent.

Miscellaneous

(4) Chlorination of Ceramic Materials: (i) Mirpur red clay is supposed to contain iron as ferric hydroxide. To remove this iron from it the clay was subjected to dry chlorination at temperatures of 100 to 500°C with chlorine gas. Iron could not be removed preferentially under these conditions and further investigations are required to obtain improved results.

(ii) Sand (obtained as by-product of washing of Bijaipur clay) mixed with carbon and containing 98.58% of SiO_2; 0.4% Fe_2O_3; 0.5% Al_2O_3

and 0.4% alkali, was subjected to chlorination by dry chlorine gas in a silica tube heated at elevated temperatures (700—1000°C). Silica remained unattacked upto 800°C, the extent of reaction at 1000°C was also not appreciable. Higher temperature is necessary for preparing silicontetrachloride from sand. The use of catalyst is to be investigated.

Project Associates: M. A. Biswas, Siddique Ahmed and M. Qudrat-i-Khuda.

(5) The Preparation of Silica Gel: The preparation of silica gel from sodium silicate has been studied. Silica gel of good absorbing properties has been prepared and the optimum condition for the process determined.

Examination of a slate-like clay procured from Sylhet gave the following new analytical results SiO_2, 63.03; Al_2O_3, 18.38; Fe_2O_3, 7.05; CaO, 5.80% and loss on ignition 5.80%. This clay appears to be a good raw material for artificial slate making. Investigations in this direction are in progress.

FOOD AND FRUIT RESEARCH

(1) Nutrition Section: (a) Studying of Fish Spoilage Mechanism: The study on fish spoilage mechanism has been continued (for previous report see Biennial Report 1959 & 60, p. 116). The results obtained from the tyrosine value determination of as such and pepsin digested sample of fresh and spoiled Ruhi Naola, Katla Naola, Mirgel Naola, Kalibaus Naola, Lata Shole, Baila, Koi and Shingi fishes show that during pepsin digestion a certain amount of protein is hydrolysed into simpler amino acids since the tyrosine value ranges between 0.02-0.4% in the case of fresh fish and in the case of spoiled fish it is 0.07-0.14%. The difference of tyrosine value in the fresh and spoiled fish shows that during spoilage autolysis takes place. These results are corroborated by later work on 'Gaja' and 'Foli' fishes. In this connection it may be said that moisture content of the above fishes were also determined and the value found to be between 74 and 80%.

(i) The total reducing values of fresh and spoiled "Mirgel Naola", "Ruhi" and "Baila" fish have been determined which show that the above values decrease during spoilage.

(ii) Boiling treatment causes a decrease in the non-protein nitrogen contents as is evidenced by the results obtained from the determination of fresh and boiled "Ruhi Naola", "Mirgel Naola", "Kalibaus Naola" and "Koi" fishes.

The same observation stands in the case of the results obtained from the determination of total, inorganic and protein phosphorus contents of fresh and boiled "Ruhi Naola", "Mirgel Naola", "Kalibaus Naola" and "Koi" fish.

The above results also apply to 'Gaja' and 'Foli' fishes.

(iii) Catalase activity has been estimated in Katla, Koi, Shoul, Taki, Gajal, Prawn and Baila.

Some samples of fish particularly "Guramachh" and "Hilsa" have been brine pickled and stored at room temperature. Occasional checking of its quality by determination of tyrosine values and other tests have shown that they were in good condition even after one month of storage.

The optimum time of brining as preliminary to curing has been determined for several species of fishes.

Project Associates: M. Qudrat-i-Khuda, N. M. Khan, H. N. De and A. Mannan.

(2) STUDY OF THE RELATIONSHIP OF ASCORBIC ACID AND ANTHOCYANIN IN VEGETABLES: The work on the estimation of ascorbic acid in vegetables and various pigmented and non-pigmented sources and a study of its relationship with the anthocyanin pigments has been continued(vide Biennial Report 1959 & 60, p. 117). The underlying idea was to find out whether the ascorbic acid content increases with the ripening of the vegetables. For this study ascorbic acid was estimated separately in the skin, seed and flesh of both green and ripe vegetables. In the skin of green "Kakur" it was found to be 68 mg. % and in the skin of yellow "Kakur" 226.6 mg. %. Ascorbic acid estimated by this method in different "Semais" prepared in our division such as that of starch with egg and sweet potato "Semai" was 3.9 mg.%. As with the indophenol method trouble arises in case of anthocyanin pigmented sources due to colour of the latter, other methods were tried, and indophenol-xylene method was found suitable. Ascorbic acid and its equivalent were estimated by this method in China rose, "Rose", "Barbati", "Lalshak", "Turnip" and "Mesta". However, with this method the figures obtained for the ascorbic acid content were found to be much lower than given by the indophenol method. In the case of China rose it was 3.75 mg.% by the xylene method, whereas the indophenol method gave a value of 34.5 mg. %.

Project Associates: M. Qudrat-i-Khuda, Omar Farooque and H. N. De.

(3) STUDY OF BIOCHEMICAL AND NUTRITIONAL CHARACTERISTICS OF RAW AND PARBOILED RICE: The work on parboiled rice has been continued (for previous work see P.C.S.I.R. report 1959 & 60, p. 121). Boiled rice from twelve samples of sun dried and parboiled paddy was prepared (Badshabhog, Naizersail, Jhingasail, Bhasamanick, Patnai 23, Dharail, Kumari, Khasia Panza, Dudswar, Hashikalni, Dalwar and Kataktar) and standardised methods were applied for the determinations of total and inorganic phosphorus, total nitrogen and non-protein nitrogen and tyrosine value of sun dried and parboiled rice from each sample of paddy. It was observed that the total phosphorus content decreased from 0.348% to 0.339% where as the inorganic phosphorus content increased from 0.0266% to 0.057% due to parboiling. The increase of inorganic phosphorus may be

due to the breakdown of phytin-phosphorus. The nitrogen content decreased from 1.268% to 1.252% whereas the non-protein nitrogen content increased from 0.018% to 0.026% due to parboiling. The tyrosine value increased from 0.900% to 0.9448% due to parboiling. The increase in tyrosine value may be due to the hydrolysis of nitrogen. Further work with the other samples of rice is in progress.

Further the comparative action of saliva and cooking on both raw and parboiled rice were investigated. It was found that parboiled rice was more readily acted on by saliva than raw rice and during cooking the latter needed more water. The gruel of both varieties of rice were examined for starch content. There was more of it in the gruel of raw rice, thus, showing that in cooking it there is more loss of starch in this case than in the case of the parboiled variety.

Project Associates: M. Qudrat-i-Khuda, J. C. Debnath, H. N. De and M. Hoque.

(4) Reducing Sugar Estimation of Vegetables After Salivary Action: Sliced vegetables such as Dhundal, Brinjal, Cauliflower, Bean, Papai and Barbati have been treated with saliva and then the sugar content estimated. It was found that there was small increase of sugar after incubation with saliva.

Project Associates: M. Qudrat-i-Khuda, J. C. Debnath and H. N. De.

(5) Study Of Fish: (a) Analysis Of Fish: The work on different varieties of fishes has been continued. The protein, moisture, ash, calcium, phosphorus, copper and iron contents were determined. The fishes examined were Baila, Baus, Naola, Baim fish, small Fali fish, Gaura, Hilsha and Katla Naola.

It appears from the data that moisture content usually varies from 69.43% to 84.50% being least in Hilsha fish.

As regards protein and ash contents it varies from 16.9 to 21.34%, and 0.87 to 1.33 per cent respectively.

Iron and copper contents vary from 0.0023 to 0.0032 p.c. and 0.00048 to 0.00068 p.c. respectively.

(b) STUDY ON PROTEIN FRACTIONS OF FISHES: Different solvents have been used to extract the protein fraction of fishes. The results are tabulated below:

Moisture content	69.00% to 86.00%
Total protein content	15.00% to 23.00%
Water extract protein contents	5.38% to 9.75%
NaCl extract protein content	2.65% to 3.02%
Cold alcohol extract protein content	0.95% to 1.56%
Boiling alcohol extract protein content	0.13% to 0.76%
NaOH extract protein content	2.26% to 5.84%

FISHES EXAMINED: Small prawn (2″ in length), Big prawn (12″), Shail fish (13″), Shingi fish, Baila fish, Ruhi fish of three different sizes (8.5″, 10.4″, 30″).

It is noted that the maximum amount of protein. 5.38% to 9.75% was extracted with water i.e. 32 to 49% of the total proteins.

Sodium chloride extract contained 2.65% to 3.02% protein i.e. nearly 13 to 19% of the total proteins.

It was further noted in the case of Ruhi and Prawn that with the increase of size there is fall in the protein level.

Project Associates: N. M. Khan and H. N. De.

(c) FURTHER STUDIES ON FISH PROTEINS: Partition of proteins of fish skeletal muscle in terms of non-protein nitrogen (NPN), total nitrogen (TN), protein nitrogen (PN), total salt soluble protein nitrogen (TSPN) and insoluble protein alongwith further separation of the pure protein into myogen (albumin) and myosin (globulin) have been carried out. The fishes examined were Koi, Magur, Shingi, Lata, Serpunti, Hilsa, Baila, Shrimp, Morula and Khorsula, Frog leg meat and wild cat flesh.

In the case of the fishes the following results were obtained.

TSPN as percentage of TPN	85 to 95%
Insoluble protein Nitrogen as percentage of TPN	5 to 15%
NPN as percentage of TN	10 to 14%
Myosin as percentage of TPN	85 to 90%
Myogen as percentage of TPN	10 to 15%

Project Associates: M. Hoque and A. Mannan.

(d) Studies on the Digestability of Fish Protein in vitro: The digestability of fish protein *in vitro* has been examined by subjecting muscle to hydrolysis using (1) 20% hydrochloric acid and autoclaving at a pressure of 15 lbs., and (2) 0.4% pepsin and N/10 hydrochloric acid.

In the first case it was found that the maximum time required for the completion of the hydrolysis of fish as measured by the liberation of α-amino nitrogen was 20 hours.

In the second case it was observed that hydrolysis beyond 24 hours leads to loss of α-amino nitrogen, most probably as ammonia.

Project Associates: M. Hoque and A. Mannan.

Fish Flour: Fish flour using different varieties of fishes have been prepared and used in admixture with sweet potato flour to prepare macaroni.

Project Associates: N. M. Khan and H. N. De.

(6) Vegetables Analysis: Moisture, Protein, Ash (Ca, P, Cu and Fe) contents of "Potato", Patal, Lady's finger, Brinjal, Daata, Jhinga, Sweet potato, Shasha, Karolla, Papaw, Bean, Barbati, Palong Shak were studied.

(a) Composition of Vegetables: The values indicate the range.

Moisture content	70.00	to	90.00%
Ash content	0.59	to	4.50%
Protein content	1.00	to	5.00%
Calcium content	0.0015	to	0.57%

Iron	0.00013	to	0.1121%
Copper	0.00031	to	0.0049%
Phosphorus	0.01500	to	0.0301%

(b) STUDY OF DIFFERENT PARTS OF VEGETABLES: Protein, moisture and ash contents were determined for different portions of the vegetables "Papaw", "Radish", "Barbati", "Seam", "Shasha", "Palong Shak" etc. Usually each kind of vegetable was divided into 3 portions namely skin, flesh and core. Protein, moisture and ash contents were determined for each portion separately.

It is found from the data that the variation of protein, moisture and ash contents of the different portions was as follows:

Portions of Vegetable	Moisture %	Protein %	Ash Content %
Skin	84.13-94.24	1.09-4.57	0.79-1.30
Flesh	86.00-94.25	0.51-1.20	0.71-1.01
Core	86.09-95.00	0.62-1.08	0.72-1.05

It is observed that the concentration of protein is greatest in the skin and least in the flesh.

Another series of similar analyses have given the following results:

Parts examined	Moisture %	Protein %	Ash %
Skin	85.25-87.50	1.10-4.50	0.79-1.40
Flesh	86.50-95.40	0.6- 1.50	0.65-1.01
Core	85.90-95.00	0.59-1.08	0.68-1.65

Project Associates: M. Qudrat-i-Khuda, E. H. Bhuiyan and H. N. De.

(7) FURTHER STUDIES IN VEGETABLES: Red and white potatoes have been examined for their protein, starch and sugar contents.

The following results were obtained.

Variety	Protein %	Starch %	Sugar %
Red	8.00-10.00	58.00-68.00	0.80-1.40
White	6.00- 8.60	69.90	1.26-2.26

Some vegetables were analysed for their protein, moisture and sugar contents. These were found to be in the range of 0.60-1.40%, 89.00-94.00% and 0.60-1.40% respectively. Cooking or salivary action did not show any significant rise in reducing sugar.

Project Associates: M. Hoque and N. H. De.

PROTEIN FROM PEANUTS: The Composition of peanuts were determined: shell, 22.9%; husk, 4.9%; seed, 71.3%.

The seeds were analysed for fat and protein contents: fat, 52.3%, protein, 31.2%. The defatted seed showed a protein content of 80.6%.

(8) STUDY OF ASCORBIC ACID CONTENT IN FRUITS AND VEGETABLES: The study of the ascorbic acid contents of fruits and vegetables has been continued.

Vegetables	Ascorbic Acid mg %		Ascorbic Acid mg %
Pui Shak	11.33	Ladies Finger	9.71
Palong Shak	6.60	Kaida	4.25

Lal Shak	14.80	Jhinga	4.10
Data Shak	5.46	Banana	4.14
Jute leaves	28.33	Putal	11.03

Fruits

Banana	5.96	Kamranga	10.70
Black berry	80.00	Jalpai	21.54
Lichi	14.49	Chatta	2.92
Kagji lebu	25.63		

(9) ESTIMATION OF NATURAL PROTEINS IN HERBS AND VEGETABLES: The percentage composition of herbs and vegetables in terms of mois ture, lipid, crude protein, ash, fibre and meal were first carried out. The protein extracted was further analysed. Positive tests for giberillic acid type products were also obtained.

Water hyacinth has been examined in this way.

(10) STUDY OF THE DIGESTIBILITY OF HERBAGE PROTEINS: Biological values of some vegetable proteins were determined by digesting *in vitro* with pepsin and N/10 hydrochloric acid.

True protein nitrogen, non-protein nitrogen and available nitrogen in the hydrolysate as well as in the unhydrolysed vegetables were determined. Some biological values are quoted below:

Water hyacinth 49.2, Spinach 77.3 and Cauliflower 72.9.

Miscellaneous Studies

The pigments of natural food have been examined. Those of coloured fish and shell fish have been identified as astacin and astazanthin.

Extraction of deoxyribo nucleic acid (*DNA*) has been carried out from the core of the palm plant and the milts of Hilsa fish. The latter seems to be a good source of DNA.

Isolation of cystine from hydrolysis products of human hair and fish scale has been attempted with partial success so far. A very small sample of impure cystine has been isolated. Attempts are being made to purify it.

Variation in Dehydrogenase activity of different parts of "Kul" with the growth of the fruit were studied. It was found that dehydrogenase activity was initially nil in the skin, flesh and seed but with growth it increased in all the parts being least in the flesh.

Total acidity, and distribution of citric and tartaric acids in Mesta seeds and flesh have been determined.

Sugar cane juice analysis in terms of specific gravity, pH, total acidity, percentage of solids, reducing and non reducing sugars has been done.

Wiking Eiweiss (*i.e. substituted eggwhite*) samples have been prepared using salt soluble fraction of fish protein.

Variation of the content of ascorbic acid with ripening of the fruit in the skin, flesh and seed of "Kul" and mango was studied. It was observed that with the increase of the anthocyanin content in the skin as maturity was reached, the ascorbic acid content also increased in this part, whereas it diminished in the seed and the flesh.

Microflora level of different food products under study :

(i) Semai from potato starch	48×10^6/g
(ii) Semai from sweet potato and fish flour	30×10^7/g

Anti-bacterial activity of 'Ganda' flower has been observed when alcoholic extractives were used against *E. coli*.

Nutritive values of fishes have been examined. Fishes studied were 'Bhetki', 'Kalabous', 'Ilish' and 'Gajar' in the fresh, boiled and spoiled conditions. Further studies are continuing with "guramachh" (the chief source of protein for East Pakistan) and cat fish.

(11) Certain Specific Features of Some Typical Fruits: (a) Akar (*Alangium lamarkii*): The edible fruit pulp of Akar has been analyzed completely; its vitamin C content (112 mg/100 gm.), acidity (9%) on fresh weight basis and reducing sugar (15%) on dry weight basis, are quite high. Such reducing sugars in the pulp have been identified as glucose and fructose by paper chromatography. The high percentage of potassium (2.3) and calcium (0.35%) as minerals on dry weight basis, are remarkable.

(b) Amlaki (*Phyllanthus emblica*): Three varieties of amlaki (large greenish, small greenish and whitish types) have been fully analysed. Characteristic variations in vitamin C content were observed (large one with 300-400 mg. and small variety with 400-600 mg/100 gm). The amlaki fruits invariably got decomposed within 2-3 days at room temperatures and in two weeks in the cold (about 0-2°C) with loss in vitamin C also.

(c) Papaya Pectin: Tow types of pectins have been isolated from papaya (unusual for the same fruit). They are as follows:

A. Material	Percentage of Fruit	Types of Pectin
Pectin from whole papaya	5.58* 27.9**	Total mixture
Pectin from the Alcoholic extract	1.5*	Alpha
Pectin from acid hydrolysis of the residue	3.5*	Beta

*Fresh weight basis **Dry weight basis

B. Samples	Galacturonic acid content %	Methoxyl group %	Specific Rotation
Pectin	74	9.81	220
Pectin	67	13.49	210

(d) CITRUS FRUITS: The special variety of pomelo, "bashpati" of North Bengal and "Jahaji Lebu" of Sylhet were fully analyzed. Vitamin C contents were found to be high (120.4 and 245.0 mg% respectively). Glucose, fructose and sucrose were the sugars present in both. Lime varieties have already been examined. (*Pakistan J. Agr. Biol. Sci.*, **2**, 73, 1959).

(e) GAMAR (*Gmelin arborea*): All proximate analyses on this fruit showed its contents as 7.7% sucrose (fresh weight) detected and identified by paper chromatography free of any other sugar.

(f) BANANA: The work on bananas has been continued (for previous work see P.C.S.I.R. Biennial Report 1959 and 60, p. 123-126). Some varieties were analysed.

(i) ANALYSIS OF BANANA

Types	Sizes cm. dia	Pectin %	Sugars %	Moisture %	Vita-minC mg.%	Protein %	Fat %	Total weight in gms.
Musa Sapientum Culliver (Sagar)	11.5 × 16	1.7	5.1	78.0	11.2	4.36	0.6	117
Musa (Sabri)	10 × 8.4	0.7	6.3	71.0	8.1	4.82	0.7	41
Musa Kabri	12.5 × 9.5	0.9	1.4	67.5	4.0	2.18	0.5	74
Musa Bhim Sagar	15.5 × 15.5	0.6	3.1	75.0	0.4	4.31	0.3	204

(ii) BANANA HONEY AND JELLY: The honey (water 21%, protein 0.3%, glucose 32%, fructose 31%, sucrose 2.3%, etc.) and jelly (71% suspensoids with 1% tikernose and 60% sugar) were prepared from pulp extracts of banana which were first thoroughly filtered and concentrated.

(iii) BANANA FLOUR: The banana pieces were cut under citric acid (1% solution) and dried at 80°C and then powdered and kept in dessicator making desired banana flour.

(*iv*) GREEN BANANA (*Katchkola*): Green banana is mostly used as vegetable. It has been analysed—fats, 0.295; protein, 4.86; starch, 56.82; fibre, 0.46; ash 2.86% with high contents of iron 1.3% and potassium 1.01% on dry weight basis. Isolable starch from the above source by water leaching, falls within the range, 35-45% (dry weight) of the original materials. Green banana is very low in reducing and non-reducing sugars, pectin, acid and vitamin C.

Project Associates: P. K. Das and N. A. Khan.

(g) LICHI (*Lichi chinensis*): The different parts of the Lichi fruit have been analysed.

Fruit coats contain pentosans 23.25%, cellulose 0.82% and fat 2.4% on dry weight basis.

Fruit pulp contains acid 4.01% as citric, reducing sugar 10.36%; non-reducing sugar 7.29%, pectin 1.85% and vitamin C 182 mg. per 100 g. on wet weight basis.

Seed kernels contain moisture, 37.60% reducing sugar 2.50%, non-reducing sugar 4.33%, pectin 4.82% on a wet basis. They have been found to be a rich source of starch (61.7%). Protein content was 13.82%.

Only glucose and sucrose have been identified in the extracts of the pulp and kernel.

The microscopic and photomicrographic features of starch particles have been studied.

Project Associates: P. K. Das and N. A. Khan.

(12) PEANUT AND PEANUT PRODUCTS: (a) PREPARATION OF MILK: Milk of a composition almost reaching natural limits has been prepared. The milk had a pH 6.4, and a composition—solid contents, 10.2; fat 4.3 and protein 3.1%. The pH has subsequently been raised to 8.1 by addition of sodium bicarbonate solution; for, at this pH the milk seemed to be more stable. Further attempts at enriching the milk are under way.

Even after extraction of one batch of milk, the peanut residue was found to be a good food source.

(b) Peanut Proteins: Protein has been obtained from the defatted peanut meal and separated into albumin, globulin, glutelin and phosphoproteins.

Further, the water-soluble protein fraction of peanut has been separated. The yield varied in the range of 11.0-16.0% by weight of defatted peanut powder. The sample was 81.0-88.0% pure protein.

Project Associates: M. A. Hossain and N. A. Khan.

(13) Beverage from Cane Juice: Sugar cane juice was first analyzed. pH-6.5, solids 23.3 g. reducing sugar, 1.94 g. non-reducing sugar, 17.34 g., acid (as citric) 0.8 g. per 100 ml. were the data obtained.

The juice was then clarified by boiling with lime followed by treatment with carbon dioxide to pH 6.5 and filtration. Such clarified juice may be employed for preparing any artificial beverage available in the market by adding the requisite flavours and preservatives.

(14) Soluble Sugars—Fruits: Ten varieties of bananas were analyzed for soluble sugars chemically and through paper chromatography. The 'Sabri' and 'Sagar' varieties of bananas contained only sucrose and a variety containing seeds, glucose and fructose; the rest had all the three sugars. 'Chalta' also contained the three sugars in it. Citrus limes contained only glucose.

These results appear to have interesting relation with regard to their taste and their acceptance as food.

Banana Behaviour in Cold: On maintaining at 2-3°C in the cooler spotty character developed in four types of bananas in the number of days noted against the species 'Sagar', 3 days; 'Sabri', 2 days; 'Kabri', 5 days; and 'Bhim Sagar', 4 days-after the first yellowing stage, indicating enzyme action.

Tamarind: The isolated tikernose [*Chem. Ind.* 1413 (1959)] was partially hydrolyzed by taka-diastase in phosphate buffer at 28.5°C [*Nature*, **184**, 1140 (1959)] through different intervals of time (10 minutes, 30 minutes, 1 hour, 1½ hours, 2 hours, 3 hours, 6 hours overnight). These hydrolysates gave indications of three products, by selective precipitation containing xylose, galactose and glucose, for their existence as three branches in main polysaccharide tikernose [*Chem. Ind.* 1413 (1959)].

Further experiments are contemplated for confirmation. The acetylated and benzoylated derivatives of tikernose are awaiting characterization. The preliminary investigation on "End-group Analysis" of tikernose through periodic acid oxidation gave rough ideas of the branched chains in tikernose.

Project Associates: M. Qudrat-i-Khuda, N. Islam Howladar, M. A. Hossain, M. A. Rahman, M. M. Ahmad and N. A. Khan.

(15) Protein from Different Sources: (a) Tamarind Kernel Proteins: (i) The protein (amount present in kernel 19%) was isolated as noted earlier [*Chem. Ind.* 1413 (1959)] and subjected to analyses (88.6% protein, 3.84% pentosan, 4.65% fibre, 0.99% ash) and hydrolysed to amino acids which were characterized by paper chromatography and partially identified as glutamic acid, serine, glycine, threonine, alanine, arginine, tyrosine, phenylalanine, and isoleucine.

(ii) Protein hydrolysates (partial) were prepared by heating the sample of protein in 2N hydrochloric acid below 60°C under controlled conditions for 4 hours with agitation.

(iii) Glue was prepared by treatment with very dilute and weak acid below 0.1 N strength under specific conditions and its adhesiveness and storage life studied with added preservatives. Castor and linseed proteins also yielded low-grade glues.

(b) Fish Protein Amino Acids: Three samples of protein from 'Hilsa', 'Puti' and 'Prawn' have been prepared and hydrolyzed to amino acids which were analyzed by paper chromatography, uni-and two-dimensional, and established in each case as:

Hilsa : Aspartic acid, glutamic acid, cystine, serine, glycine, alanine, lysine, arginine, tyrosine, leucine, phenylalanine, proline, methionine, histidine, threonine.

Prawn : Aspartic acid, glutamic acid, cystine, serine, glycine, alanine, lysine, arginine, leucine, phenylalanine, proline, valine, methionine, histidine.

Puti : Aspartic acid, glutamic acid, cystine, serine, glycine, alanine, lysine, arginine, tyrosine, leucine, phenylalanine, proline, valine, methionine, histidine.

The proximate analyses of the above fishes were also completed. The notable feature lies in the oil contents varying according to the seasons, summer, rainy and winter and physical condition of the fish (particularly, if they are egg laying—those of hilsa from 14.0-20.0%, puti 7.0-12.0%. Prawn gave a low value of 1.2%.

The quantitative determination of these amino acids is in hand.

Project Associates: M. Qudrat-i-Khuda, N. Islam Howladar, M. Quddusur Rahman, and N. A. Khan.

(16) Cereal and Cereal Products: Microscopic identification of different varieties of starch has been used as a mean of identifying the component starch mixtures.

As this would be of use in detecting adulteration of standard starch products the study has been extended. Thirty four varieties of starch—products of East Pakistan, used as foods have been under such microscopic examination and their characteristic features recorded by means of photographs for future reference in identification work.

Analysis of "Maow Alu": Dioscorea has been found to represent a typical starchy sample, (moisture 66%; reducing sugar 2.86; non-reducing sugar, 2.6; fat, 0.27; protein, 5; crude fibre, 8.15; starch, 59; free acid, 0.2; pentosans, 14.9; minerals: iron 0.019; phosphorus 0.07; calcium, 0.98; sodium 0.3; and potassium 1.0%).

Both "Ghechu" and Shaluk" have been analysed. "Ghechu"—fat 1.1%, starch, 71.1% proteins 9.12%; fibre 3.25%; ash 1.27% on dry weight basis. "Shaluk"—fat 1.1%; starch, 60.83%; protein, 5.6%; ash, 1.33%.

The local grains like Kaon and Cheena showed starch contents of over 60% in preliminary analyses.

(17) Fats and Oils: The following animal fats have been examined: 1-4, Hilsa Oil, and Ox, Goat and Ram Fats: The fatty acids of these samples were separated through their urea complexes into fractions rich in saturated acids (iodine number 0-30) oleic acid (I.N. 50-96), linoleic (I.N., 140-200) and other higher unsaturated acids (I.N. above 200). This indicated the possibility of their preparation in the pure state for different purposes,

(18) VITAMIN E (TOCOPHEROLS): The importance of tocopherols as antioxidants and as biologically active components in the body (vitamins) has led to the analyses of all our available oils for these constituents.

Microgram of Vitamin E/gm Oil

Oils	Market variety	Ghani-pressed	Solvent extracted
Mustard	324	532	—
Coconut	244	258	—
Groundnut	163	—	580
Sesame	135	157	—
Jute seed oil	—	—	577
Bazna seed oil	—	—	302

Project Associates: M. Qudrat-i-Khuda, H. C. Das, M. A. Rahman, Nurul Islam Howladar and N. A. Khan.

(a) ERUCIC ACID FROM MUSTARD OIL: As a literature survey indicated that pure erucic acid had not been prepared so far through the methods available, an attempt was made to prepare the same by urea complex fractionation. The pure acid (iodine value 73.61, molecular weight 340.45; theoretical iodine value 74.0, molecular weight 338.0) was obtained in a yield of 25%. Methyl, ethyl, propyl, butyl and amyl esters of erucic acid have been prepared. The acetylenic acid (behenolic) has been prepared from the methyl ester of erucic acid (yield, 24.8%; m.p. 48.5°C).

Project Associates: M. A. Rahman and N. A. Khan.

(b) LOSS OF TOCOPHEROLS IN VEGETABLE OILS: Mustard, sesame and groundnut oils (Ghani-pressed) were analyzed at intervals of one month for vitamin E (tocopherols). It was found that the latter completely disappeared in (i) 6 months from mustard oil, (ii) 3 months from sesame oil, (iii) 4 months from groundnut oil.

After these periods, the respective oils were found to be malodorous, having an unpleasant flavour and unfit for human consumption. Such

deterioration can be prevented by the addition of an antioxidant in proportion to the amount of tocopherols present.

(c) To Examine the Composition of Fats and Oils: The methyl esters of the fatty acids of groundnut, sesame, puti fish and mustard oils have been prepared by acid catalysed esterification and purified by fractional distillation *in vacuo*. The study of the fractions continues.

The degree of hydrogenation in different market products have been estimated through their melting points, iodine value and consistency. The crystal structures have shown considerable variation from sample to sample and so have their contents of solids.

The effect of different metals on the stability of mustard oil has been studied by storing the oil with different metals such as iron, copper, nickel and aluminium. The sample with aluminium did not develop any off odour but the other samples did. Further work is continuing.

LEATHER RESEARCH

(1) Preservation of Hides and Skins, Substitute for Khari Salt: The work on the preservation of hides and skins has been continued (for previous work, see Quinquennial Report, p. 97). A substitute for the imported Khari salt was the objective. Different mixtures of common salt, sodium carbonate, sodium sulphate and a fungicide for example, sodium flouride, naphthalene, sodium pentachloro-phenate were tried. Khari salt preserved hide was used as control.

It has been found that a mixture of common salt and sodium carbonate in a certain proportion along with sodium pentachloro-phenate as fungicide is equally good as 'Khari' salt.

(2) Tanning Materials: Bahera (T. bellerica): A member of the Terminalia family found in East Pakistan is *T. bellerica*, Bahera, which is known for its medicinal qualities. Bahera fruits were analysed during the middle of the 19th century for their tannin content, however, no record is available of its use as a tanning material.

The fruits have now been examined for the tannin contents with the following results:

	Aqueous extract of			Extra solids
	Air dry Dekernelled fruit	Pulp, fleshy protein of the fruit	Dekernelled fruit stone	
Total solids	19.28	33.65	4.00	92.8
Total solubles	19.04	33.60	3.90	91.3
Tannins	8.58	13.60	1.40	31.4
Non-tannins	10.46	20.00	2.50	59.9
Insolubles	74.06	64.90	85.75	1.5

Moisture	6.90	1.50	10.35	7.2
Total	100.00	100.00	100.00	100.00
Ash	—	—	—	5.0%
Reducing sugar (on the basis of air dry fruit)				1.5%
Non-reducing sugar	—	—	—	1.5%

The oil of the air-dried Bahera fruit is used as a household remedy for various diseases. It constitutes the major part of "Triphala oil" which is employed as a hair tonic. It also finds use against rheumatism and ophthalmia. Therefore, alongwith the examination for the tannin contents the amount of oil in the seed was also determined. Oil (on the basis of the dry fruit) 2.5%. Oil (on the basis of the weight of the kernel) 34%.

The ash analyses on a qualitative basis were also done to determine if any harmful metals were present. Iron was found present but no copper could be detected.

The nature of the tannins was found to be of the pyrogallol type.

(a) Experiments in Tanning with Local Materials: (i) Bahera: Bahera is a pyrogallic tanning material. Its tannin content is not high. Besides, the delimed pelts are rendered black on tanning with Bahera extract.

Therefore, blending with other extracts was attempted. Blends of Bahera and Goran extracts in certain proportions have given good results. One of these blends produced leather of a very satisfactory colour. Further experiments in this line are in progress.

Bahera extract in the blended form has been successfully used for tanning lining leather like calf skin, sheep or goat skins, the hides of cows and buffalows. Bahera has also been used for combination tannage for shoe upper and belt leathers with good results.

(b) Tanning with Waste Liquor from Paper Mills (Kraft Lignin): Tanning experiments with Kraft lignin in presence of urea, and formaldehyde were conducted at pH 8.5-9.0. Leather obtained was dark in colour. The degree of tannage appeared low. Further experiments for improving colour and other factors are in hand.

(3) SULPHONATION OF KRAFT LIGNIN: Lignosulphonic acid is in use as an auxiliary tanning material for over fifty years. The disadvantage with it is that it is hydrophyllic because of the presence of sulphonic acid groups; the leather is detanned by washing.

The paper mills in Pakistan produce large quantities of waste liquor containing lignin. These paper mills follow the sulphate method yielding an alkali lignin which is precipitated on acidification. This as such is not useful as a tanning material, as tanning is carried out in an aqueous medium which is acid. Therefore, in order to keep the lignin in solution under acid conditions it was decided to introduce sulphonic acid group into the benzene ring bearing the phenolic groups intact. Sulphonation experiments with sodium metabisulphite so far have given products in which 20-25% of the lignin has been rendered soluble at pH 3.5. Further experiments are continuing.

FURS: Attempts were made to produce furs from some of the available skins and to use the technique for more useful furs at a later date.

The process of aldehyde tanning was also adopted for making fur leather but the results were not satisfactory.

CHROME TANNING: The tanned fur and wool skins were dried in the air and were shaved on the flesh side. The bases of the skins were treated with degreasing solvents so as to free them from the fatty substances. The hairs, after bleaching, were mordanted with different mordanting solutions according to the shades desired. They are then dyed, and finally polished.

Attempts to product *parchment leather* were successful to a certain extent.

CHAMOIS LEATHER: Several pieces of chamois leather were made from sheep skin by the process of oil tanning with the application of "Puti" fish oil, on the delimed pelts.

WHITE PICKER BANDS: Some pieces of calf-skins were subjected to the process of sulphur tannage. Delimed pieces of skins were pickled for some hours in a solution containing salt and sulphuric acid. This with thiosulphate solutions helped sulphur tanning and white picker bands were finally obtained.

TRANSPARENT LEATHER: The previous method of making transparent leather was modified a little by introducing nitro-benzene into the system of operation and it was seen that growth of micro-organism could be prevented if cellulose nitrate could be used in the finishing of the leather.

Project Associates: Moslem Ali and A. Samad.

FATS, OILS AND WAX RESEARCH

(1) Puti Fish Oil: The bazaar variety of Puti fish oil could not be decolourized completely by Fuller's earth and animal charcoal in spite of many attempts at different conditions of temperature and with different proportions of the decolourizing agents. By treatment with special activated carbon (Norite) and a bleaching earth colourless oil has been finally obtained. On the other hand, a freshly extracted sample of the fish oil however could be decolourized readily and completely. Super-heated steam deodorization of the oil has been attempted. The product though rid of a great deal of the smell, still had weak fishy odour.

Winterization of the decolorized and deodorized Puti fish oil has given an oil which remained clear for 2 months. During the process stearine was separated to the extent of 40%.

Project Associates: S. Adhikari and M. Qudrat-i-Khuda.

(2) Waxy Material from Andrographis paniculata Leaves: In continuation of the work on *Andrographis paniculata* leaves, reported in Biennial Report 1959 and 60, p.95 and also elsewhere in these reports, Paniculata wax A, m.p. 84-85°C and a hydrocarbon named andrographane, m.p. 67-68°C have been obtained from the petroleum ether extracts on concentration and cooling. On purification of the mother liquor by chromatography, another wax, paniculata wax B m.p. ca. 30°C, a sterol m.p. 135°C, and two other thick oily fractions have been obtained. The infrared spectra of the waxes A and B indicated the presence of an ester carbonyl group. Paniculata wax B could be hydrolysed with difficulty to an alcohol, m.p. 15°C and an acid, m.p. 77°. The infrared spectrum of the alcohol showed absorption peak at 3472 $c.m.^{-1}$

The compound melting at 135°C was found to be a sterol as it gave positive Liebermann—Burchard and Salkowsky tests. It is under examination and will form the subject matter of a separate communication.

From the nature of their infrared spectra and strong absorptions at 3475 cm^{-1} and 3472 cm^{-1}, the two thick oils separated by chromatography on alumina, seem to be two different esters containing free hydroxyl groups. Further work on all the above constituents separated from the petroleum ether extract is in progress.

Project Associates: M. Qudrat-i-Khuda, Kshetra Mohan Biswas and M. Amjad Ali.

PHYSICAL RESEARCH

(1) Determination Of Physical Constants: The following determinations were carried out in the Physical Studies Section of the Laboratories during the course of these two years.

Serial No.	Nature of Physical Consnant	Number of determinations
1.	Refractive Index	40
2.	Specific rotation	48
3.	pH	60
4.	Density	40
5.	Ultraviolet and visible absorption spectra	284

(2) Spectrophotometric Studies: The spectrophotometric absorption study consisted of 18 varieties of local rice starches both raw and parboiled. In the case of raw rice starches, the absorption peaks were found to vary in position from 580 to 620 mμ. The study has been extended to vegetables and fruits.

Starches from both white and red potatoes have been examined spectrophotometrically. All the samples showed absorption maximum at 610 mμ.

The amylose and amylopectin content of 10 varieties of rice starch have been determined.

The spectrophotometric examination of the isomerization, characterization and estimation of different fish oils and fats has been taken up together with a similar examination of proteins from different vegetable and fish sources.

Electrophoresis experiments on paper strips were conducted with methanol and water extracts of china rose, methanol extract of 'Lalshak' protein from groundnut.

(3) Evaluation of the Thermal Insulation Properties of Solar Hats: Khaki and white solar hats and a cap supplied by the Home Department of the Govt. of East Pakistan have been examined from the stand point of thermal insulation properties. Thermal delay of the wall of the hats was determined under transient conditions. Steady state temperature difference was also estimated. Experiments were conducted both in the laboratory with artificial heat sources and outside in direct sunlight.

However more reliable means of testing their suitability for use in the hot sun of East Pakistan are being devised.

(4) Viscometers: Two types of viscometers (a) the falling sphere type and (b) the Ostwald type were designed and fabricated in these laboratories. The latter was made in three sizes. All the above instruments are showing satisfactory results in use.

(5) Different Moisture Absorption of Raw and Parboiled Paddy and Rice: A study of the influence of the relative humidity and temperature on the absorption of moisture by raw and parboiled rice and paddy were carried out through the different seasons of the year. The object was to determine the proper atmospheric conditions for their storage. One important observation from the work done so far is that with almost every sample examined the greatest amount of moisture absorbed is at or around relative humidity of 80%. Further work is continuing.

The effect of cooking on the size of rice grains has been examined for about a dozen varieties of raw and parboiled rice. It was observed that the percentage increase in dimensions for the raw variety was greater in the case of raw than of the parboiled.

For determination of Transistor parameters the bridges and amplifiers have been built up. Such measurements are useful for design purposes.

Project Associates: N. A. Khan, H. N. De, A. Mannan, M. B. Das, Nurul Huq and M. Yasin.

CHEMICAL ENGINEERING

(1) Processes under Study: (a) East Pakistan peat has a comparatively high ash content. Flotation technique could be applied to reduce the ash content prior to briquetting. A detailed flow sheet of the process and specifications of all the equipments needed for a pilot plant have been prepared.

Meanwhile, the specifications of a peat briquetting plant were received from a German firm but no flotation equipment was provided in it. It is expected that a plant would be procured from abroad and necessary additions and modifications in the unit could be effected in accordance with requirements. The preliminary cost estimates of a peat briquetting plant producing 5,000 tons per annum show that the selling price of Rs. 2.00 per maund would leave a good margin of profit.

As peat briquettes contain about 40% of volatile matter, they were subjected to carbonisation at a temperature of 250-350°C with satisfactory results. The treated briquettes were almost smokeless with a higher calorific value of 10.000 B.T.U/lb. Moreover some by-products can be obtained. This study is in hand.

(b) Coconut: During the period under review, work has been continued on the extraction of coconut oil from coconut by the cold process developed in these laboratories. The yield of oil was 21.6% of the kernel.

Furfural has been prepared from the digestion products of coir dust. Attempts are being made to make paper and board from the coir.

(c) Lemon Grass: The lemon grass distillation plant has been installed. A heat exchanger has been designed and fabricated for it in the workshop. It is an auxiliary to condense the waste steam and feed it back as water to the storage tank.

The study of lemon grass distillation on the pilot plant scale is in hand.

(2) Designing and Economics of Pilot Plants: (a) The designing of a pilot plant for solvent extraction of curcumine and oil from tur-

meric has been started and the flow sheet with specifications of the equipment required have been prepared.

(b) The destructive distillation of wood has shown promising results on the laboratory scale investigations. To study the process on a pilot plant level a detailed report on the economics of the wood distillation pilot plant was prepared. Besides, a statement showing the cost of construction of the plant, annual cost of maintenance and annual returns from the sale of products, a design of the retort with detailed drawings for semi-continuous operation and with specifications for the machineries needed for the separation and purification of the pyroligneous acid was also prepared.

Besides, the designing and costing of pilot plants for the following have also been taken up:

(*a*) Sugar from molasses; (*b*) paper, cellophane and rayon from jute sticks; (*c*) extraction of jute seed; (*d*) extraction of Nata seeds and leaves.

(3) Installation of Apparatus: During this period the following instruments, machines and plants were brought into commission.

(i) Aerogan gas generator; (ii) Laboratory mineral hydraulic press; (iii) Apparatus for the determinations of the melting point of ash; (iv) One shaking type autoclave and two revolving types; (v) Colour fastness tester; (vi) Some remaining Condex Grinding mills; (vii) Other remaining testing machines for Rayon section; (viii) Paste mill; (ix) Ice-making plant; (x) Permutit Deminrolit plants; (xi) Kneading machine; (xii) A Granulating machine; (xiii) A Hydrogenation apparatus; (xiv) Ozone apparatus; (xv) Vacuum extraction, distillation and evaporation pilot plant; (xvi) Air liquefaction plant; and (xvii) Viscose pilot plant with spinning machines and several testing machines for textile thread and yarn.

(4) Workshop Jobs: Besides normal maintenance, 322 jobs of various types were undertaken for other sections of these laboratories during the year—1962.

Project Associates: G. M. Ahmad, A. K. Sikdar and M. Raquibuddowla.

INDUSTRIAL MICROBIOLOGY

(1) Citric Acid from Molasses: During these years 9 more citric acid producing micro-organisms have been isolated (for previous work, see Biennial Report 1959 and 60, p. 107.). Work on production of citric acid has been carried out using all these organisms. Experiments were carried out both by surface and submerged culture methods using eleven different media. The above results have shown that none of the organisms could produce citric acid in submerged culture method. Of the total acid produced by different organisms, 5-10% is oxalic acid and the rest citric acid. The results of citric production was encouraging only in case of organism No. 21. The effects of variation in the concentration of molasses, and potassium ferricyanide and of pH were studied for organism No. 21. The optimum conditions were found to be, concentration of molasses 25 %, of potassium ferricyanide 0.18% and pH 6.5. The maximum quantity of citric acid produced was 20% of the weight of molasses and 40% on the weight of its sugar content.

To identify the organisms specifically, morphological, cultural and biochemical characteristics of the organisms were studied. From these studies all these organisms have been found as different strains of Aspergillus niger.

All the organisms produced maximum quantity of citric acid in 8-9 days. The optimum temperature for the production of citric acid was 30-32°C. The potimum sugar concentration was 12.5%. Further work is continuing.

Further 22 citric acid producing molds have been isolated from stale bread, out of them 5 have produced significant amounts of citric acid. Study in this regard is continuing.

Project Associates: M. Qudrat-i-Khuda, N. M. Sheikh, A. K. Joardar and S. Ansar Ahmed.

(2) Yeast Fermentation: For the production of yeast *Torulopsis utilis*, N.C.Y.C. 359 was used.

The yield of yeast was 28-30% of molasses on dry basis and 56-60% of the sugar content of molasses. The yeast contained 47% of pro-

tein and 6-7% ash. The ash contained potassium, aluminium, calcium, copper, iron, magnesium and silicon..

Increase in the concentration of molasses beyond 2.5% diminished the yield of yeast.

Experiments on the production of yeast from molasses, using different concentrations of inorganic salts have also been conducted.

Project Associates: S. Ansar Ahmed, N. M. Sheikh and S. Hedayetullah.

(3) Lactic Acid Fermentation: The organism *Lactobacillus delbueckil* was used for the production of lactic acid from molasses by fermentation. The fermentation broth contained malt, calcium carbonate and 20% molasses. The optimum temperature for fermentation was 37°C and the fermentation was completed in 5 days. The yield of lactic acid was 40% of molasses and 80% of the sugar content of molasses. Lactic acid was obtained as colourless calcium lactate.

The Rhizophus group of moulds has also been used for lactic acid fermentation. Five different strains of the Rhizophus group have been isolated from soil in this laboratory. One of them has been used for fermentation studies with molasses by the surface culture method. The main product was lactic acid; the optimum temperature was 30-32°C. Different concentrations of molasses and different nutrients have been tried. Using molasses at 20% concentration and malt as nutrient, a yield of 40% of the molasses content has been obtained. Further work is in progress.

Project Associates: M. Qudrat-i-Khuda, N. M. Sheikh, A. K. Joardar, S. Hedayetullah and S. A. Ahmed.

(4) Isolation and Experiments with Some Unidentified Moulds: Six coloured moulds were isolated from contaminated plates in the laboratory. These have been purified and have been used for fermentation experiments. The sugar in the fermentation media was all consumed in 14-23 days.

(5) Studies on the Factor in Water Hyacinth which Promotes the Growth of Micro-organisms: Water and methanol extracts of the stem and the roots of water hyacinth have been found to enhance the growth rate of *Aspergillus niger* (the micro-organism used for these

experiments) by 60%. These extracts have been separated into different fractions, some active and others inactive. The carbon, nitrogen and ash contents of the different fractions have been determined.

Further work is continuing.

(6) Taxonomy of Laboratory Contaminant Fungi: Forty organisms have been isolated from culture plates and other substrata like sugar solution and glycoside extract as laboratory contaminants. They have been studied by culturing them on Czapek's or Waksman's media.

The identified organisms are listed according to their class below:

Phycomycetes:

(a) *Rhizopus arrhizus*

(b) *Syncephalastrum racemosus*

(c) *Cunninghamella verticillata*

Ascomycetes:

(d) *Aspergillus nidulans*

(e) *Aspergillus glaucus gr.*

Fungi imperfecti:

(f) *Aspergillus niger*

(g) *Aspergillus clavatus*

(h) *Aspergillus sachari*

(i) *Aspergillus sydowi*

(j) *Aspergillus fumigatus*

(k) *Aspergillus terreus*

(l) *Penicillium citrinum*

(m) *Penicillium oxalicum*

(n) *Penicillium piceum*

(o) *Penicillium lilacinum*

(p) *Penicillium implicatum*

(q) *Curvularia lunata*

(r) *Chacetonium funicula*

(s) *Spicaria divaricata*

(t) *Trichoderma viride*

Project Associates: Rawnak Ara (Miss), and S. Hedayetullah.

(7) Bacteriological Study: Six different bacteria have been isolated from drain water, root nodules of leguminous plants and conta-

minated plates. Five bacteria are gram negative and one is gram positive. All are rod shaped except one which is oval.

Further study on the isolated bacteria is being continued.

Project Associates: S. R. Chowdhury and S. Hedayetullah.

Pharmacology

The pharmacology section has been set up in this period and a project on the effect of potassium nitrate on the blood sugar level has been taken up.

WEST REGIONAL LABORATORIES

ORE DRESSING AND METALLURGY

(1) Extraction of Lead from Galena: Galena occurs in the Hazara district in West Pakistan. Experimental conditions, under which lead could be produced from the indigenous galena ore have been investigated.

The reaction between the ore and the locally available auxiliary materials has been studied under variable conditions of temperature, time and quantities of reactants. The results on the laboratory scale having been shown successful, the process has now been extended to the pilot plant scale.

Project Associates: Allah Bakhsh Chaudhry, Mahmood Husain and Karimullah.

(2) Anodising and Colouring of Aluminium Articles: Anodising and colouring the articles with different organic dyes have been successfully achieved. Different brightening agents have been carried out to produce multi-colour impressions on the anodised articles. These studies can now be beneficially exploited on an industrial scale.

Project Associates: Mohammad Inam, Allah Bakhsh Chaudhry, M. K. Bhatty and Karimullah.

(3) Dolomite as a Raw Material for the Production of Magnesium Salts: The raw materials for the production of magnesium salts are dolomite, magnesite and magnesium bearing brines. Dolomite has been recently shown to be present in many localities of Pakistan. Studies were, therefore, carried out for the production of magnesium sulphate and magnesium chloride from dolomite. The two salts have been prepared on the laboratory scale with satisfactory results.

Project Associates: Allah Bakhsh Chaudhry, Mohammad Inam, M. K. Bhatty and Karimullah.

(4) Aluminous Clay as a Raw Material for the Production of Aluminium Salts: Alum is used in textile, tanning and paper indus-

tries, and for sewage treatment. It is manufactured in the country from the imported bauxite. Although bauxite is not easily accessible in Pakistan, aluminous clays are abundantly available in the salt range. Experiments conducted on a pilot plant scale have shown that a method for the production of alum from the clays can be economical. Patent coverage for the process is being obtained.

Project Associates: Allah Bakhsh Chaudhry, Mohammad Inam, M. K. Bhatty and Karimullah.

OILS, FATS AND WAXES

(1) Composition of Some Lipids: (a) Mazri Seed Oil: Mazri shrub (*Mannorhops ritchieana*) grows wild and in abudance in all the arid and semi-arid zones of West Pakistan. Mazri seeds at present find little use. The seeds are hard, stone-like, spherical nuts having about 1 cm. diameter. The yield of the seeds per tree is 3-4 lbs. per annum. Preliminary studies indicate that the seeds can constitute a source of mannose. The seeds yield over 10% of their weight of an oil and it has the following values: Percentage of the oil from seeds =10-11, Saponification value =259.8, Iodine value =8.6, Acid value =0.19, Non-saponifiable matter =1.04%.

The oil is of non-drying nature and has a high saponification value and it smells like coconut oil. It could prove a suitable substitute for coconut oil. A paper has been sent for publication.

Project Associates: Ihsan-ul-Haque, Mohammad Ilyas Qureshi, M. K. Bhatty and Karimullah.

(b) Thuja Oil: *Thuja orientalis* ('mor-pankhi') is grown as a decorative plant in areas all around Lahore. Seeds of the plant contain both essential and fixed oils. The essential oil has been used for scenting tobacco and as tincture for therapeutic purposes. The chemistry of the essential oil has already been studied. The fixed oil from this plant has now been studied as regards its saturated and unsaturated fatty acids. The different values of the oil determined are as follows: Hexabromide value =34.23%, Saponification value =180.609, Maleic anhyd. value =28.736, Bromine value =124.50, Iodine value =89.62, Solid acids =6.526, Acetyl value of the liquid =0.999, Hydroxyl value =16.603.

Project Associates: Nasir-ud-Din Zahid, M. K. Bhatty and Karimullah.

(c) A Fixed Oil from the Tubers of Paeonia emodi: The drug is medicinally used and it yields about 2% of an oil, which has a characteristic odour. The chemistry of the oil is being fully investigated. The non-saponifiable matter of the oil consists mainly of β-sitosterol. The composition of oils, mentioned in sections (b) and (c) is being worked out by vapour phase chromatography.

Project Associates: Nasir-ud-Din Zahid, M. K. Bhatty and Karimullah.

(2) KHAWI GRASS WAX: Besides the essential oil, khawi grass also yields about 1.2% of a waxy substance. The melting point of the crude wax is 73°. It contains solid hydrocarbons, traces of free acids and esters and considerable amounts of free alcohols. The characterization of these compounds is being carried out.

Project Associates: Mirza Nasir Ahmad, M. K. Bhatty and Karimullah.

(3) AGAVE WAX: During the process of isolation of hecogenin from Agave, a wax is also obtained as a bye-product. The wax is soft having m.p. 81-85°. Since the content of the wax is large (about 2-2.5%), attempts are being made to study it as a substitute of carnauba wax.

Project Associates: Mushtaq Ahmed, Iftikhar Ahmad, M. K. Bhatty and Karimullah.

(4) CHEMICAL INVESTIGATIONS OF PAEONIA EMODI WALL: The work on the fresh samples of *Paeonia emodi* Wall, has revealed that the drug, when fresh, contains primarily salicylaldehyde besides starch, sucrose, tannic acid and traces of benzoic acid. As the drug grows old on storage, the salicylaldehyde gets converted into salicyclic acid, which on further degradation changes into benzoic acid. The drug, which had been kept for over 6 months, contains almost an equivalent amount of benzoic acid but no salicyclic acid. It is, concluded that a degradative enzyme is in operation and as such it brings about the conversion of the original salicylaldehyde into benzoic acid.

Further work is in progress.

Project Associates: Nasir-ud-Din Zahid, M. K. Bhatty and Karimullah.

(5) STUDIES ON CLERODENDRON INERME: *Clerodendron inerme* is widely grown in this country as a hedge plant in gardens. Work on *Clerodendron infortunatum* has already been done in India and the U.K. The isolation of a bitter substance, clerodin, has been reported. However, no work has been carried out on this species. Its leaves are bitter in taste

and have a typical smell. The leaves are used in poultice making. The shrub is also known as 'quinine-e-bostani'.

A crystalline product, m.p. 232-233°, bitter in taste, has been isolated from the steam distillate of the leaves of this plant. The petroleum ether extract of the leaves gives a wax, m.p. 65°, an orange yellow oil and a crystalline compound m.p. 192°. The latter two products are also bitter in taste.

Further work on the identification of these compounds and the determination of their constitution is being continued.

Project Associates: Mahboob Elahi, Iftikhar Ahmad, M. K. Bhatty and Karimullah.

(6) Separation of Erucic Acid from Rape Seed Oil: Erucic acid, which is present to the extent of 50% in Toria (rape and oil), is a substance of commercial importance being used in the manufacture of soaps, emulsifiers, lubricants, waxes and plasticizers.

For its separation in bulk quantity, urea adduct method has not proved very successful. Solvent crystallisation at low temperature has given promising results. Further work is in progress.

Project Associates: Jamil-ur-Rahman, Mushtaq Ahmad, M. K. Bhatty and Karimullah.

(7) Synthesis of Alkyl-Aryl Substances: (a) Long Chain Derivatives of Phenol: Phenols and substituted phenols with long alkyl chains possess physiological properties. *p*-Methoxy phenyl amyl carbinol and 3:4 dimethoxy phenyl amyl carbinol have been prepared. Various methods to convert the alcohols to the corresponding saturated side chains are under study.

Project Associates: Mushtaq Ahmad, Mohammad Ilyas Qureshi, Iftikhar Ahmad, M. K. Bhatty and Karimullah.

(8) Activation of Clays for Decolourizing Vegetable Oils: In continuation of our previous work a critical study of activating clays has now been carried out. The effect of temperature on acid and the effect of the strength of acid have been investigated.

(9) Aromatic Chemicals from Turpentine Oil: Tentative processes are now ready for the production of terpin hydrate, terpineol and synthetic pine oil from turpentine oil.

To avoid cooling during the process, which enhances the cost of production, investigations are being carried out to produce these materials from turpentine oil at room temperature or even at higher temperatures.

The production of synthetic pine oil can be taken up as such. Samples of this oil are being tested and evaluated.

Project Associates: Mirza Nasir Ahmad, Iftikhar Ahmad, M. K. Bhatty and Karimullah.

(10) Utilization of Khawi Grass: Work has been undertaken to obtain menthol-like material by reduction of ketonic bodies present in Khawi grass essential oil. Indications have been obtained signifying the possibility for the conversion of pipertone, (which present in the oil to the extent of about 6%) into a material having menthol-like odour. Further work on this problem is being continued.

Project Associates: Mirza Nasir Ahmad, Iftikhar Ahmad, M. K. Bhatty and Karimullah.

FOOD TECHNOLOGY

(1) Physical and Chemical Characteristics of Different Varieties of Wheat: The common varieties of wheat grown in Pakistan e.g. C 273, C 271, C 518, C 591 and Pb 14 have been classified with respect to their physical and chemical characteristics.

From the extensibility figures it has been found that C 271, C 591, and C 273 are good for chapati and bread making whereas Pb 14 and C 518 are fair for chapati and bread but good for biscuit making.

The amylase activity of all these varieties of wheat falls within the range of 610 to 785 amylograph units with the exception of Pb 14 which has a very low (127 units) amylase activity. Further work is in progress.

Project Associates: Rahmat U. Qureshi, A. S. Alvi and Mohammad Aslam.

(2) Biological Evaluation of Foodstuffs: Biological values of various Pakistani dishes and meals have been determined by rat-feeding experiments.

Attempts have been made to incorporate seed cake proteins in human diets. The biological value of guarseed protein determined under standardised condidions at 10% level was as low as 27; even the cooking did not improve it; the value for cottonseed meal under similar conditions was 52. When the rats are weaned on a formula diet containing guarseed protein, they lost weight, hair and sight; mortality rate rose from 30% in the first week to 75% in the fourth week. Cottonseed meal made a good supplement giving an appreciable rise in biological value.

A technique has been developed by which obnoxious odour of the sun-dried salted Karachi sea fish has been removed, salt content reduced to the minimum acceptable level and the reconstituted tissue rendered soft. The product thus obtained is palatable and acceptable. The biological value of such a preparation is 74.

Project Associates: Rahmat U. Qureshi and M. Yusuf I. Haq.

(3) Pilot Dietary Survey of Families in Lahore: On a request from the Directorate of Nutrition Survey and Research, a Pilot Dietary

Survey of 400 families was conducted in Lahore. The information obtained was submitted to the Directorate for compilation and report.

Project Guide: Rahmat U. Qureshi.

(4) AGE HEIGHT, WEIGHT, AND DIETARY STATISTICS OF CHILDREN: Height and weight according to age is a reliable index for the study of nutritional standard of a population. A survey of the age, height, weight and dietary statistics of Lahore school children is being conducted. About 5000 boys and girls have so far been surveyed and the work is still in progress.

Project Associates: Rahmat U. Qureshi and F. R. Malik.

(5) CLARIFICATION OF SUGARCANE JUICE: The present work was undertaken to improve the quality of Khandsari sugar in order to meet the shortage of sugar in the country. It was also in view to process sugarcane juice into such products which can be used in place of sugar i.e. golden syrup, soft drinks etc.

The present method describes the clarification of sugarcane juice on cottage scale and its decolourisation and clarification for soft drinks and syrup with a view to improving the yield of sugar and to obtain useful products of cane juice.

Project Associates: Ehsan Ali, M. H. Hashmi and Karimullah.

(6) MANUFACTURE OF SAGO: Sago is a processed edible starch marketed in the form of small globules or pearls. It was originally manufactured in Malaya and East Indies from the starch obtained from the pith of the stem of several palms, the principal being the sago palm (*Metroxylan rumphii* or *Metroxylan sagus*). A process has been evolved for the preparation of sago maize starch. The product prepared in the laboratory is comparable to the imported material in its cooking qualities.

Project Associates: Ayyaz Ahmad, Ehsan Ali, M. H. Hashmi and Karimullah.

BIOLOGICAL EVALUATION AND FERMENTATION

(1) Studies in the Biochemistry of Micro-organisms: The mold *Curvularia siddiqui* has been found to produce four new metabolic products, when grown on liquid synthetic media viz. Curvulin, $C_{12}H_{14}O_5$, m.p. 145°C; Curvulinic acid, $C_{10}H_{10}O_5$, m.p. 218°C., and Curvulic acid, $C_{12}H_{14}O_7$, m.p. 154°C (dec.). The constitutions of these products have been investigated and those of Curvulin, Curvulinic acid and Curvulol have been established.

The constitution of Curvulic acid is under investigation.

A paper entitled: 'Biochemistry of Micro-organisms. I. Curvulin, Curvulinic acid, Metabolic products of *Curvularia siddiqui*', has been accepted for publication in *Tetrahedron*.

Project Associates: A. Kamal, Nasir Ahmad, M. Ali Khan and I. H. Qureshi.

(2) Bone Gelatine and Bone Phosphate: After gelatine has been extracted completely from bones, the residual bone powder is dried and ground to 80 mesh. This material represents a source of readily available phosphorus and calcium. Bone phosphate has been analysed and found to contain magnesium, citric acid, sulphate and organic matter in addition to calcium and phosphorus. The product so obtained will be beneficial in general for those whose basal diet is wheat and in particular for children who require more calcium for growth. The manufacture of mono-calcium phosphate from bones is an important constituent of baking powder prepared in our laboratories. It is quite comparable to the imported material and the process by which it has been made is commercially feasible.

Project Associates: Mohammad Saeed, Mohammad Sadiq, and Karimullah.

(3) Gossypol-free Cottonseed Flour: Potentials of cottonseed meal as human food are being explored in our laboratories. Studies on eight varieties of cottonseed such as L-11, L-9, F-124, F-199, AC-180, AC-257, AC-184 and AC-134 with respect to their proteins, fat, hulls, kernels, total gossypol and ash have been completed. Some other varieties of cottonseed are also being studied in order to select the most suitable

ones for use as a human food. Gossypol-free cottonseed flour has been prepared both from cakes and whole seeds by a very simple process. The colour of the flour so obtained is yellow to brown depending upon the variety of the seeds and cake used. This flour can be incorporated in wheat to the extent of 10% without changing the palatability of the bread. The flour containing slightly over 50% protein will approximately cost 50 paisas, per pound. Storage qualities of the flour are good.

Project Associates: Mohammad Nazir, Mohammad Saeed and Karimullah.

(4) Proteins from Vegetables and Grasses: Work on the extraction of proteins from plant materials and grasses such as *Erythrinia indica*, *Albizzia lebbek* (Sirin), *heterophragma*, *Dalbergia sissoo* (Sheesham), *Avena sativa* (Jai), *Trigonella repens* (Shattala) pear grass and *Sesbania aegyptica* (Jantar) has been completed. Using rats as experimental animals it has been found that biological value of the proteins of *Erythrinia indica* is as good as that of wheat protein. Jantar leaves can yield protein flour containing as high as 40% protein. Yield of the flour on the basis of fresh leaves is 10%. Studies on the amino acid composition of Jantar leaves are in progress.

Project Associates: Mohammad Afzal Malik, Mohammad Saeed, Mohammad Islam and Karimullah.

(5) Production of Algae as Human Food: Various strains of algae were studied by growing them under different conditions prevailing in our country. Conditions have been established to grow them on the simplest salt media and artificial light. Algae dried at 60 °C is free from undesirable odour and possesses acceptable taste and colour. Algae powders of protein contents ranging from 18% to 22% on dry weight basis have been prepared. Economic aspects of the problem are being studied.

Project Associates: Mohammad Saeed, Ali Gohar and Karimullah.

(6) Culture Collection and Antibiotics: Work on the isolation and identification of micro-organism from grapes, banana, dates, aalu-bukhara, fresh manure, soil and grass is being continued. The object of this work is to collect and maintain a number of suitable strains of industrially important micro-organisms. As a result of systematic investigations, pure culture of yeast, molds and *actinomycetes* have been isolated from the above mentioned sources. The most important among those isolated are

the species of *Aspergillus niger*, *Penicullium*, *Streptomycetes*, *Saccharomyces*.

Project Associates: Mohammad Arshad, Mohammad Saeed and Amir Mohammad.

(7) PRODUCTION OF CALCIUM GLUCONATE: Studies on the production of calcium gluconate from glucose by fermentation with *Aspergillus niger* have been completed. Experiments to utilize molasses for the production of calcium gluconate, are in progress.

Project Associates: Nawazish Ali and Mohammad Saeed.

(8) PRODUCTION OF AMYLASE FOR DESIZING IN THE TEXTILE INDUSTRY: Previous work on the production of amylase was concerned with the use of *Bacillus subtilis* as a source of the enzyme. New species of *Aspergillus niger* and *Aspergillus oryzae* are now being tried under controlled condition of temperature, pH and aeration. Attempts are being made to utilise molasses as the main sources of carbohydrate in the growth medium.

Project Associates: Mohammad Aqil and Mohammad Saeed.

(9) VINEGAR MANUFACTURE: After completing work on the manufacture of vinegar from sucrose as well as molasses, new experiments have been started to prepare ready mix vinegar powder. Reconstitution of the powder is carried out by mixing with either sugarcane juice or water solution of another powder and allowing it to ferment for a few days. Another experiment is being carried out to prepare vinegar powder which does not require any fermentation period.

Project Associates: M. A. Wahid, Amir Mohammad and M. Saeed.

(10) PRODUCTION OF BAKER'S YEAST: Large scale production of *Saccharomyces cerevisiae* (Baker's yeast) from molasses in a locally designed fermenter has been completed. It has been possible to obtain a yield of 26% dry yeast on the basis of sugar in the media. The pressed cake of yeast thus obtained contains 30-35% solids and is quite active even after storage for three weeks in refrigerator. Attempts to prepare active dry yeast, which will last for at least 6 months have been quite successful. The daily out-put of the fermenter is about 1 lb. dry yeast.

Project Associates: Tanweer-ul-Hussain, Mohammad Saeed, M. A. Wahid and Karimullah.

(11) Protein Hydrolysates: Lysine is one of the essential amino acids in which cereal diets are deficient. Protein hydrolysates from gelatine and animal blood have been prepared, and they contain appreciable amount of lysine and other amino acids. A lysine rich powder of amino acids prepared from these hydrolysates will be available at cheap rates. It may be mixed with cereal flour to provide the supplementary effect.

Project Associates: Mohammad Hayat, Mohammad Saeed and Karimullah.

(12) Studies on the Chemistry of Smuts: Ustilagic acid isolated from smuts of maize has become industrially important compound on account of its application in perfumery industry.

Preliminary microscopic examination of the local wheat smut has shown it to be similar to *U. tritici* (obtained from Japan). Chemistry of both these strains is being studied after growing them on suitable media.

Project Associates: Mohammad Saeed, Nawazish Ali and Karimullah.

GLASS AND CERAMICS

(1) Preparation of Low Temperature Earthenware Glazes: Most of the furnaces in operation in the country are working at a maximum temperature of 1100°C. which is rather low for good quality glazed wares. To meet this low temperature glazes have been formulated. The Pakistani raw materials for glazes contain sufficient iron to impair the product and give it a yellow to brown tint. To mask this defect opaque glazes have been produced. Low-lead glazes have been formulated to avoid dangers of toxicity due to lead.

Various properties of the glazed wares manufactured in the Division's oil-fired furnaces have been thoroughly studied. Some of the glazed wares have been found quite satisfactory for large scale production.

Project Associates: Azizul Haq and F. A. Faruqi.

(2) Preparation of Sanitary Ware Glazes: Glazes for tiles, and other sanitary wares in general should be comparatively more abrasion -resistant. Zirconia and titania bearing glazes are quite abrasion-resistant, but they require a higher temperature to mature. Investigations were, therefore, made to formulate glazes maturing at the lowest possible temperature. A few glazes have already been formulated maturing between 1200-1250°C. Most of their qualities, both apparent and intrinsic, compare quite well with the imported wares. These glazes can be used with excellent results on earthen-wares bodies as well.

Project Associates: Azizul Haq and F. A. Faruqi.

(3) Preparation of Over-glazed Colours: Most of the household wares are decorated for the purpose of which colours are required. These colours are either under-glazed or over-glazed. In the case of opaque glazes over-glazed colour is used. Uptil now all the various ceramic industries are employing imported colours. However, it is not difficult to produce these colours within the country from the indigenous raw materials. It was with this view that investigations were undertaken for the production of a number of decorative over-glazed colours (which are entirely imported so far) from indigenous raw materials.

Various shades of blue, green, yellow and brown colours have also been formulated. Formulations of reds, pinks, violets, crimsons and creams are in hand.

Production of Glutamic acid from the Slaughter House waste being carried out in the West Regional Laboratories, Lahore.

The study of solid state reaction in the Glass and Ceramics Division of the West Regional Laboratories.

Experiment for the preparation of Leaf protein in the Biological and Fermentation Division of West Regional Laboratories.

Ceramics Research Unit of the West Regional Laboratories.

Project Associates: Azizul Haq and F. A. Faruqi.

(4) Studies and Preparation of Seger Cones: In ceramic industry Seger cones are employed as internal temperature indicator. Attempts have been made to produce quality seger cones from indigenous raw materials. A number of formulations have been made for about twenty different temperatures between the range 700 to 1100°C.

Project Associates: Mohammad Yasin, Azizul Haq and F. A. Faruqi.

(5) Preparation of Chrome Refractories and Chrome-magnesite Bricks: Chrome refractories and Chrome-Magnesite bricks are employed extensively in the iron-steel furnaces. They will be in great demand, when work is started on the proposed steel plants in the country. Various types of bricks using different grades of indigenous chromite ore and bonding agents have been made. Their porosity, permeability, cold crushing strength, thermal shock resistance etc., have been studied.

Magnesite, having the least hydration tendency, has been prepared by calcining above 1500°C. Coarse grades of chromite and fine grades of calcined magnesite have been mixed together with and without bonding material. After firing, the bricks give satisfactory performance.

Project Associates: Mohammad Ibrahim and F. A. Faruqi.

(6) Permeabilities of Pakistani Fire Bricks: Bricks of less permeability are usually corroded in all types of furnaces, particularly, when the molten mass is in contact with the furnace bricks as in the case of glass tank furnaces. This property of the bricks is a serious drawback, especially when they have to be used for constructing glass-making furnaces.

Permeability of various Pakistan fire bricks has, therefore, been determined by a simple, and yet accurate apparatus designed and made in the laboratories. It has been concluded that locally made fire bricks are more permeable than required and still need improvement in their quality.

Project Associates: Mohammad Ibrahim and F. A. Faruqi.

(7) Production of High Mullite Fire Clay Bricks: The work is in hand for the production of fire clay bricks from the indigenous mate-

rial. The end in view is to have bricks of high mullite content, because the quality of mullite formed in a brick plays a major part in resisting the glass attack. The results so far obtained are quite encouraging and satisfactory.

Project Associates: Mohammad Ibrahim and F. A. Faruqi.

(8) PREPARATION OF CAST-IRON ENAMELS FROM PAKISTANI RAW MATERIALS: In Pakistan, very little work has been done so far in the field of enamelling. A number of formulae, both for ground-coat and over-coat, and for a wide variety of colours ranging from white, cream, brown to green, blue and black have been developed utilizing indigenous raw materials, and their applications have been studied.

Project Associates: Mohammad Yasin, Azizul Haq and F. A. Faruqi.

(9) STUDY OF THE PHYSICAL AND CHEMICAL PROPERTIES OF VARIOUS PAKISTANI CERAMIC RAW MATERIALS: About a hundred and fifty samples, comprising of various ceramic raw materials like clay, feldspars, talcs, limestones, chromites, magnesites, bauxites, sands, etc., which are understood to be available in different parts of West Pakistan have been thoroughly studied for their physical and chemical properties to ascertain their suitability in the ceramics industry. Reports concerning the same have been compiled.

Project Associates: M. Sharif and F. A. Faruqi.

(10) ANALYSIS OF AND SPECIFICATIONS FOR THE INDIGENOUS GLASS-MAKING SANDS: Four samples from newly discovered deposits were investigated for their suitability in glass manufacture in continuation of the previous work on 'the Glass-making Sands of Pakistan'.

On the request of Pakistan Standards Institution, Karachi, specifications regarding glass-making sands were prepared on lines similar to those of BSS and ASTM, keeping, however, in view the availability of quality and composition of the Pakistani sands.

Project Associates: Ghulam Rasul and F. A. Faruqi.

SOLAR ENERGY

(1) Projects on Utilization of Solar Energy: (a) (i) Solar Engine: A new hot air engine working on solar energy has been designed and fabricated. The small solar engine runs at 400-700 R.P.M. and draws its energy from a paraboloid search-light mirror. A bigger engine is being designed.

(ii) Solar Steam Generator: A 16 sq. ft. area solar steam generator with 1 x 1 sq. ft. mirrors developing a pressure of 15 lbs. per/sq. in. and evaporating about one pound water per hour, has been studied and a concentrator with 18 sq. ft. area but having a concentration ratio of solar radiation of 70 to 1 is being fabricated.

(iii) Solar Water Pump: A direct solar water pump using ammonia as the working material and water as the absorbent has been tried. The difficulties encountered in its practical operations have been determined and a design of SO_2 silica gel system is being examined.

Research Worker: M. Saif-ul-Rehman.

(b) (i) Solar Cooker: Various types of solar cookers were designed and tested. An absorption type solar cooker consisting of a small wooden box, blackened inside and covered with a window glass has been found to be simple and convenient to use. The loss of heat through the window while placing the kettle in the box or taking it out is minimized. The difficulty, that the moisture given out by the food during cooking condenses on the window glass, has also been solved.

Patent application for the cooker has been filed.

(ii) Solar Water Heater: The device is suitable for supplying hot water for domestic needs of a small family. The essential components of the heater are embodied in one unit to eliminate heat losses and make it portable so that it can be kept on the roof of a house without disturbing the construction of the building.

(iii) Solar Drier for Fruits and Vegetables: An absorption type solar drier has been designed which considerably reduces the time

of drying as compared to drying by the open air method. Fruit and vegetables dried in it are hygienic, and free from dust microbes. Condensation of the moisture, given out by the vegetable on the inner surface of the glass during drying, can also be removed easily.

An application for patent coverage has been filed.

Research Worker: Ehsanullah Khan.

(c) SOLAR STILLS: A device which can be utilized for getting distilled water at low cost has been designed at these laboratories. It can be easily used anywhere without consuming much space. The distillation of water begins within one hour after the device is kept in the sunshine.

Project Associates: Ehsanullah Khan and Karam Elahi.

CHEMICAL ENGINEERING

(1) Rubber-lined Equipment: Suitably designed rubber-lined equipment can stand corrosion and abrasion and thus can replace expensive materials like stainless steel etc. Rubberised tanks can be used for storage and transportation of corrosive liquids. The dyeing baths in textile industry, and pickling baths can be made of concrete tanks lined with rubber.

The process developed consists of rubber latex and other ingredients easily available in the country as the starting materials. The compounding of latex can be varied to suit the working conditions. The compounded latex is, then, sprayed on the prepared surface. The method dispenses with the use of imported machinery and rubber to metal adhesives required in the conventional sheetlining method.

Project Associates: Mansoor Hussain, Mahmood Husain and Karimullah.

(2) Epoxy Resins: These resins are amongst the latest thermosetting plastics. Their ever-increasing formulations have explicitly tailored properties including chemical inertness, heat resistance and good adhesion. Metals, which cannot be welded together, can be easily bonded firmly with these resins. The resins have been synthesised from phenol, acetone and glycerol as the starting materials. The results on a laboratory scale have been encouraging and the work is in progress to get better formulations.

Project Associates: Manzoor Husain, M. Yunus, Mahmood Husain and Karimullah.

(3) Plant and Equipment Fabrication: (a) Tubular Reactor for Alcohol Cracking: The reactor was designed for cracking alcohol into diethyl ether. The catalyst is placed in the tubes, which can easily be taken out from the shell. The tube column can be uniformally heated by radiation from a series of heaters fixed on the inner walls of the shell and the heater can also be controlled for the required heat gradient. The reactor has been found to give quantitative conversion of alcohol into ether on a pilot scale.

Project Associate: Mahmood Husain.

(b) LEACHING COLUMN: The designed column can be used for (i) ore-leaching; (ii) decolourization of organic liquids; and (iii) extraction of oil from seeds. The column has been so designed that the liquid enters the bottom and the solid is fed from the top with the help of a screw conveyor. The solid is directed downwards by scrapping blades from plate to plate and counter current to the liquid and it finally comes out at the bottom and after having been thoroughly leached out or decolourised or freed of oil.

Project Associates: Niaz Ahmad and Mahmood Husain.

MISCELLANEOUS RESEARCH PROJECTS

(1) Organic Reactions in Aqueous Solution: Organic syntheses in aqueous solution under cell-possible conditions as studied by Haley and Maitland (*J. Chem. Soc.* 1951, 3155) have been further extended. Some of the reactions studied in this connection are:

(a) Hantzsch Synthesis of Pyridine Compounds: Maitland et al, (*J. Chem. Soc.* 1951, 3155) have shown that variation of pH has a striking effect on the yields of 1:4 dihydrocollidine 3:5-carboxylate. They found that by using potassium dihydrophosphate, and caustic soda buffer, the condensation between acetaldehyde, acetoacetic ester and ammonia occurs only within pH range 6-10 giving the highest yield of 43% at pH 8.5. When ammonia was replaced by 10% aqueous ammonium carbonate, the yield of the dihydropyridine derivative was 70% at a pH of 8.5. This difference in yields at the same pH indicated that there are other factors which effect the yield. We have been able to show that ions of the buffer solution have a greater effect on the yield than pH. We obtained sizeable yield of the compounds at pH much lower than 5, where Maitland et al could not get any compound. Similarly, we have been able to prepare the compounds, although in smaller yields beyond pH 10.

While preparing the dihydropyridine derivative Maitland et al observed the formation of some other compounds, constitution of which they have not ascertained. We have shown that along with dihydropyridine compounds, a pyridine derivative is also formed. Reaction mechanism of these syntheses in water is being studied.

(b) Synthesis of Iso-oxazolone: If ammonia in Hantzsch synthesis is replaced by hydroxylamine, a different compound is obtained. This was shown by us to be Iso-oxazolone.

Project Associates: Ahmad Kamal and Asaf Ali Qureshi.

(c) Biginelli Condensation and the Preparation of Pyrimidine Derivatives in Aqueous Medium: Biginelli in 1893 found that an aldehyde can combine with β-keto esters and urea in alcohol solution to give a tetra-hydro-pyrimidine. T.B. Johnson, et al (*J.A.C.S.* 1932, 3751) subjected reaction to variable conditions of pH and to different types of aldehydes and arrived at the conclusion that, in acidic medium the reaction

smoothly leads to the formation of tetra-hydro-pyrimidine which can be obtained in very good yield in aqueous medium, when the pH was kept from 1-7. The yield decreased with increasing pH. In case of formaldehyde, no condensation takes place in acidic medium. In alkaline medium formation of dihydropyridine takes place. However, in neutral solution a tetrahydro-pyridine was obtained in two to three days along with dihydro-pyridine. When the solution was kept for one year, the dihydropyridine was converted into pyridine, due to, perhaps atmospheric oxidation.

Project Associates: Ehsan Ali and Karimullah.

(2) Reaction in Aqueous Solutions: (i) Even dihydropyridine compounds have been prepared through the condensation of aldehydes (aliphatic, aromatic, substituted aromatic and heterocyclic), ethyl-acetoacetate and ammonia at various pH in aqueous medium. Dihydropyridine compounds have been found to possess curcare like activity and are weakly analgesic. The synthesis has been undertaken to establish a synthetic general route which is simple and gives high yields. A paper has been sent for publication.

Sulphur compounds have been generally found to be bacteriousstatic and bacteriocidal and have, therefore, been used extensively in medicine. The following trithian compounds have been prepared through the condensation of aldehydes with hydrogen sulphide in aqueous solution.

1. 2:4:6-Tri-furyl-1:3:5-trithian, m.p. 220°C.

2. 2:4:6-Tri-(3-hydroxy phenyl)-1:3:5-trithian, m.p. 142°C.

3. 2:4:6-Tri-(3-hydroxyphenyl)-1:3:5-trithian, m.p. 220°C.

4. 2:4:6-Tri-phenyl-1:3:5-trithian, m.p. 217°C.

5. 2:4:6-Tri-(4-methoxyphenyl)-1:3:5-trithian, m.p. 170°C.

6. 2:4:6-Tri-(4-nitrophenyl)-1:3:5-trithian, m.p. 185°C.

Project Associates: Ahmad Kamal and Asaf Ali Qureshi.

(ii) Fifteen di-indolyl compounds have been prepared through the condensation of aldehydes with indole, in water. These di-indolyl compounds have not been reported earlier and are under investigation for their

properties and applications. A paper dealing with each of the fifteen di-indolyl compounds has been sent for publication in *Tetrahedron.*

Project Associates: Amhad Kamal and Asaf Ali Qureshi.

(iii) Urotropin renders urine basic and has been used as urinary antiseptic. Another use is the preparation of the powerful high explosive: cyclonite. Further, urotropine has been employed in the Duff Reaction for the preparation of phenolic aldehydes and also in chloromethylation. From theoretical consideration an appropriately—CH_2—substituted urotropine can perhaps be employed for the preparation of various ketones in a modified Duff Reaction. Further appropriate substituents on the—CH_2-can be nitrated to yield explosives.

A number of—CH_2-substituted urotropines have been prepared through the condensation of aldehydes (aliphatic, aromatic, substituted aromatic and herero-cyclic) and ammonia in aqueous solutions. The corresponding hydrobenzamides were also prepared. A paper has been sent for publication in *Tetrahedron*:

Project Associates: Ahmad Kamal and Asaf Ali Qureshi.

(3) Synthesis of 2-Carbomethoxy-5-Pentadecyl-Cyclopentanone from 3-Pentadecyl-Catechol (Tetrahydro-Bhilawanol): Due to the increasing importance ascribed to Bhilawan in the indigenous systems of medicine as a cure for rheumatism, epilepsy, nervous debility, leprosy, eczema and skin diseases in general, it was considered of great interest to carry out a systematic chemotherapeutic studies on its active principle Bhilawanol. Theoretical considerations based on the presence of a long-side chain attached to the benzene ring nucleus in Bhilawanol made such a study of particular significance with reference to the therapeutic properties and structure of products like chaulmoogric and hydrocarpic acid, the cyclic acids of chaulmoogra oil.

The acids have been the subject of many chemical and biological studies. These investigations have not only been concerned with the isolation and structures of the naturally occuring cyclic acids, but have also included the synthesis of other closely related acids.

As a consequence of these observations, the present authors have synthesized 2-carbomethoxy-5-cyclopentanone from Bhilawanol with a

view to evaluating its activity against *B. leprae*. A paper is being sent for publication.

Project Associates: Salimuzzaman Siddiqui, Ahmad Kamal, Izhar Husain Qureshi, Abdul Majid Hamid and Asaf Ali Qureshi.

(4) Oxidation of Dihydropyridine Compounds: The pyridine compounds are interesting because of their pharmacological activity.

Haley and Maitland (*J. Chem. Soc.*, 1951, 3155) have shown that water at room temperature is an effective medium for some very simple condensations involving substances containing groups CHO, CO NH_2, $CONH_2$. CH_2CN,-$COCH_2$. CO. A number of dihydrophyridine compounds were prepared by Kamal and Asaf by effecting the condensation with ethyl-acetoacetate and a number of aldehydes employing water as a medium. The dihydropyridine compounds so obtained have been oxidized to pyridine compounds with potassium permanganate in the acidic medium. The following pyridine compounds have been prepared:

1. 2:6-Dimethyl-3:5-dicarbethoxypyridine, m.p. 68°C.
2. 2:6-Dimethyl-3:5-dicarbethoxy-4-phenyl-pyridine, m.p. 61°C.
3. 2:6-Dimethyl-3:5-dicarbethoxy-4 (4-methoxyphenyl)-pyridine, m.p. 48°C.
4. 2:6-Dimethyl-3:5-dicarbethoxy-4-(3:4-dimethoxyphenyl)-pyridine m.p. 99°C.
5. 2:6-Dimethyl-3:5-dicarbethoxy-4-(4-nitrophenyl)-pyridine, m.p. 110°C.
6. 2:6-Dimethyl-3:5-dicarbethoxy-4-furylpyridine, b.p. 180°C 1.5 m.m.
7. 2:6-Dimethyl-3:5-dicarbethoxy-4-propylpyridine, b.p. 132°C/1.5 m.m.
8. 2:4:6-Trimethyl-3:5-dicarbethoxypyridine, b.p. 220°C./

9. 2:6-Dimethyl-3:5-dicarbethoxy-4-(3-nitrophenyl) -pyridine, m.p. 61°C.

10. 2:6-Dimethyl-3:5-dicarbethoxy-4-hexyl-pyridine.

11. 2:6-Dimethyl-3:5-dicarbethoxy-4(2-chlorophenyl) pyridine.

Project Associates: Ahmad Kamal, Asaf Ali Qureshi and Mansoor Ahmad.

(8) SYNTHESIS OF 6:8-DIMETHOXY-ISO-COUMARIN: *Iso*-Coumarins are found in natural products. Recently a dihydro-*iso*-coumarin has been found to be present in the glucoside, blepherin. Many workers have synthesised a number of benzene ring substituted *iso*-coumarins by different methods.

The present investigations have been undertaken for the synthesis of the remaining dimethoxy-*iso*-coumarin viz. 6:8-dimethoxy-*iso*-coumarin. In the synthesis of this *iso*-coumarin the important intermediates are 3:5-dimethoxyphenylacetic acid and 2-carboxymethyl 4:6 dimethoxyphenylglyoxylic acid. At present 3:5-dimethoxyphenylacetic acid is obtained in very low yeild by Arndt-Eistert's reaction. Attempts are being made to increase the yield after which further steps to achieve the synthesis will be undertaken.

Project Associates: Ahmad Kamal and M. Akram Sandhu.

(9) SAPOGENINS FROM AGAVE SISALIANA (KEWRA): *Agave sisaliana* is locally known as 'Kewra'. The plant contains hecogenin which is a starting material for the production of synthetic cortisone. The Pakistani *Agave* species have been analysed with respect to their hecogenin contents which are from 0.2-0.4% on the dry basis.

Attempts have been made for developing an economical method for the isolation of hecogenin from the plant material.

Project Associates: Mushtaq Ahmad, Iftikhar Ahmad, M. K. Bhatty and Karimullah.

(10) Systematic Survey of Local Flora for its Vitamin 'C' Contents and the Nature of its Oils: A large number of indigenous plants have been studied with respect to their vitamin 'C' contents in the first place. Already two papers have been published in respect of this work. The present work along with the papers will now be brought out in the form of a monograph.

Project Associates: Mohammad Ilyas Qureshi, M. K. Bhatty and Karimullah.

(11) 40% Nicotine Sulphate Solution as Insecticide: Data regarding the availability of tobacco waste in the country are now being compiled. Studies have been carried out to improve the previous methods employing kerosene oil for the extraction of tobacco waste for the recovery of nicotine which can be used as a cheap and effective insecticide.

A pilot plant for this process is under construction.

Project Associates: Mushtaq Ahmad Chattha, Nasiruddin Zahid, M. K. Bhatty and Karimullah.

(12) Preparation of a Soft Drink: In continuation of our previous report on soft drink a product has now been finally prepared. It appears to meet all the requirements of a soft beverage. Almost all the materials used for this drink are indigenous. The drink is being sold on a semi-commercial scale at these laboratories.

Patent coverage for the drink is being obtained. The process is ready for commercial exploitation.

Project Associates: Akhtar Ali Saddal, Naeem Shakir, Mohammad Ilyas Qureshi, Farrukh Hassan Shah, M. K. Bhatty and Karimullah.

(13) Production of Glue from Hide Cuttings and Fleshings: A good deal of cuttings of skins and hides is obtained as by-product. These cuttings (and fleshings) find little use in the country at present.

A process has been evolved for the production of glue from the hide cuttings and fleshings. The quality of the glue is high and the yield is upto 30%. The process has already been leased out to Messrs Siddiqi and Sons, Lahore.

Project Associates: Naeem Shakir, Mohammad Ilyas Qureshi, Mohammad Saeed, M. K. Bhatty and Karimullah.

(14) CHEMICALS FROM ALCOHOL: (a) ETHER: The preparation of ether from alcohol using different catalysts has been carried out. The catalysts so far tried include sulphuric acid, silica gel, clays, kaolin and potash-alum. When the vapours of alcohol are passed through the alum catalyst at a suitable temperature, the yield of ether is over 70%. The quality of ether is comparable with that of the imported product.

(b) ETHYLENE: A high grade ethylene has also been obtained using the same catalyst at another suitable temperature.

Laboratory scale experiments indicate that the production of these chemicals from alcohol will be economical.

Project Associates: Zahoor Ahmad, Mahmood Husain, M. K. Bhatty and Karimullah.

(15) STUDIES OF THE DIGESTION CONDITIONS IN THE NON-DISTILLATION KJELDAHL METHOD: Digestion conditions have been defined in the non-distillation Kjeldahl method using hypochlorite-arsenite titrations. As standards, phenacetin and 8-hydroxyquinoline take 15 and 50 minutes respectively for complete digestion, when 30-50 mg. of either are boiled with 0.3 gm. $HgSO_4$, 2.5 gm. K_2SO_4 and 5 ml. H_2SO_4.

It has been shown that long digestion periods are unnecessary if a mixture containing 2.5 gm. of potassium sulphate and 0.3 gm. of mercuric sulphate as a catalyst and 5 ml. sulphuric acid is used to bring about the digestion in the minimum time, when the size of the sample is between 30-50 mg. The clearance of the digestion mixture does not indicate the completion of digestion, therefore, the digest is boiled further for 30 minutes to obtain the quantitative recovery of nitrogen. The addition of organic compounds to reduce the time of digestion of the heterocyclic compounds was found to be of no use.

Publication: 'Studies of the Digestion Conditions in the Non-Distillation Kjeldahl Method ' by Muhammad Ashraf, M. K. Bhatty, and R.A. Shah, *Pak. J. Sci. Research*, **13**, 171 (1961).

(16) MICRO, SEMI-MICRO AND MACRO KJELDAHL DETERMINATION OF ORGANIC NITROGEN WITHOUT DISTILLATION USING SINGLE VESSEL FOR

DIGESTION AND TITRATION: The distillation step in the usual Kjeldahl method has been successfully eliminated on the ultra-micro, micro-and semi-micro scales of analysis for different types of organic nitrogen. This elimination has been achieved by means of sodium hypochlorite exidimetric titration of the ammonium sulphate emanating from the digestion of an organic matter. However, the method employed in the determination generally involved digestion of an organic matter in a separate Kjeldahl flask followed by the transference of the digest for neutralisation and titration to another vessel. It was required to eliminate this transference of the digest, for, it consumed time and called for the use of more glass vessels. It could also be a possible source of error. Attempts to eliminate this transference were made earlier on the micro scale. Test tubes having 27 mm. diameter and 120 mm. main length with 50 mm. long neck of 15 mm. diameter were used for both digestion and titration. But the procedure was difficult in actual practice and a simpler modification here also was called for.

During the present investigations, nitrogen determinations have been accurately carried out in single vessels and transference of the digest for ultimate titration from one vessel to another has been eliminated. Simple "Quickfit" short-necked round bottom flasks with standard joints, have been used. Standard cones have successfully replaced the longneck of the usual Kjeldahl flask. Using the modified method, nitrogen has now been determined in different types of organic compounds and agricultural and animal products. The methods for the actual determination have already been reported.

Publication: 'Micro, Semi-micro and Macro Kjeldahl Determination of Organic Nitrogen without Distillation using Single Vessel for Digestion and Titration' by Muhammad Ashraf, M. K. Bhatty and R. A. Shah, *Pak. J. Sci. Research*, **13**, 191 (1961).

(17) REPLACEMENT OF SULPHURIC ACID BY GYPSUM IN THE PRODUCTION OF SUPERPHOSPHATE OF CALCIUM: Because of the abundant availability of gypsum in the country it was considered feasible that phosphorus in rock-phosphate might be made citrate soluble by treatment with gypsum in certain proportion and after the addition of certain fluxes the mass was fused at different temperatures. It has been shown as a result of experiments that the addition of certain fluxes increases the citrate soluble P_2O_5 contents to an acceptable limit. The results obtained have been quite encouraging. Further work is in hand. If these experiments are successful on a pilot plant scale, an alternative method for the production of superphosphate would be achieved.

Project Associates: Khalid Masood, Naseer-ud-Din Sheikh, and Karimullah.

(18) DEVELOPMENT OF A SOLID CARRIER FOR DDT: Locally manufactured D.D.T. is a wax-like solid. It is used commercially either as an emulsion or as a powder. Different diluents are mixed with the waxy material to convert it into powder. China clay and similar materials are the most important diluents. Since China clay, which gives good results in the manufacture of D.D.T., is not available in Pakistan, the factory at Nowshera was encountering difficulty in converting their product into a suitable powder. Consequently, they referred the problem to these laboratories. A number of solid diluents have been tried and found suitable. Some of the diluents prepared in these laboratories are now under evaluation.

Project Associates: Allah Baksh Chaudhry, M. K. Bhatty and Karimullah.

NORTH REGIONAL LABORATORIES

DRUGS AND MEDICINAL PLANTS

(1) Standardization of Some Indigenous Material for Local Pharmaceutical Industry: (a) Local Aromatic Herbs: Standardization is of paramount importance to ensure the quality and potency of herbs and drugs, so that it can contribute to the development of drug industry in a country. With a view to prepare standards for the indigenous drugs, analysis of some aromatic herbs was carried out so that it could be utilised to the best advantage by the local pharmaceutical industry. This will, ultimately, help in preparing Pakistan Pharmaceutical codex.

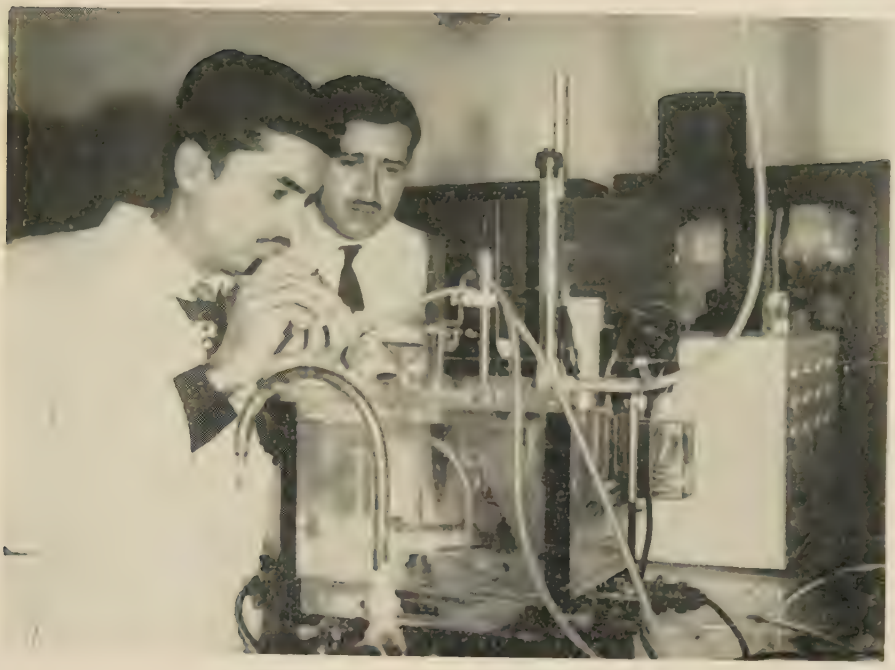
Publication: 'Standardization of some Local Aromatic Herbs. Part I' by M. A. Wahid and M. Ikram. *Pak. J. Sci. Ind. Research*, **4**, 40 (1961).

(b) Local Drugs: Medicinal Plants and herbs of great commercial and therapeutic value are known to occur in the north western part of West Pakistan and its tribal territories, yet no systematic attempt has ever been made to standardize them. Due to lack of such authentic information, local pharmacists are reluctant to use these valuable indigenous raw materials for the preparation of galenicals and other medicaments, and instead they prefer to import crude extracts of tinctures, and other pharmaceuticals.

The analytical data and information obtained as a result of the present work in which five important local drugs, aconite, cinnamomum camphora, colchicum, male fern and rhubarb have been studied, analysed and tested according to standard assay methods, and this will be useful to those engaged in the practice of medicine and pharmacy. All the five drugs are compatible with the standard laid down by I.P. codex, 1953.

Publication: 'Standardization of some Local Drugs' by M. A. Wahid. *Pak. J. Sci. Ind. Research*, **4**, 109 (1961).

(2) Conversion of Chaksini Sulphate into Chaksini Chloride: Chaksine is isolated as an easily crystallizable and sparingly soluble chaksine sulphate from the seeds of *Cassia absus* Linn. Chaksine chloride was needed for pharmacological studies and it had to be completely free from traces of inorganic impurities. It was necessary that the procedure of con-



An experiment in the Pharmacology Section, North Regional Laboratories, Peshawar.

Colorimetric Estimation of alkaloids being done in North Regional Laboratories.

Chemical Examination of fruit products, in the Fruit Technology Section, North Regional Laboratories.

Single Fibre Testing machine of the Wool Research Division, North Regional Laboratories.

version should also necessarily avoid treatment of chaksine salt solutions with alkali, since at neutral or alkaline pH, the base has been found either to isomerise or decompose evolving ammonia. In the process evolved in these laboratories advantage has been taken of replacing SO_4'' by Cl' by passing the hot aqueous solution through Amberlite IRA 400 (Cl'). The method is also capable of use in the conversion of streptomycin sulphate into the corresponding chloride.

Publication: 'Preparation of Chaksine Chloride from Chaksine Sulphate using Ion-exchange Resin' by M. Ikram and G. A. Miana. *Pak. J. Sci. Ind. Research*, **5**, 195 (1962).

(3) Phyto-chemical Studies in the Alkaloidal Contents of Plants belonging to Solanaceae Family: An investigation has been undertaken to study the variation of total alkaloidal content in the leaves of *Datura alba* and *Datura fastuosa* at different stages of the growth and biological activity of the plants. Estimations have been carried out to find the significance of the metabolic activity in the plant as reflected in the alkaloidal content, (*i*) before sunrise, when metabolic activity is practically at a stand-still; and (*ii*) at noon, when it is expected to be the maximum, and (iii) after sunset when it is again at the lowest ebb.

Project Associates: M. Ikram and A. H. Khan.

(4) Examination of Carbohydrate Contents of Some Plants: (a) Boucerozia aucheriana: *Boucerozia aucheriana* (Asclepidaceae), locally known as 'charungli' or 'pamanke' which is used as a vegetable, is being studied for its carbohydrate constituents. The results show the presence of about 4% of total sugars (reducing and non-reducing). The alcoholic extract of the plant containing oligosaccharides is under chromatographic examination.

Project Associates: M. Ikram, G. A. Miana and A. H. Khan.

(b) Cicer arietinum and Vicia faba: The changes brought about in carbohydrate contents of the seeds of *Cicer arietinum* (chana) and *Vicia faba* (bakla) during germination are under examination for detecting presence of sugars in the seeds. Preliminary examination by paper chromatography has revealed that there are eight sugars in both the seeds. The general pattern of the change in both the cases shows a very close similarity. Further work is in progress.

Project Associatess M. Ikram, G. A. Mian and A. H. Khan.

(5) CULTIVATION OF MEDICINAL PLANTS: (a) CULTIVATION OF SOME FOREIGN PLANTS: Seeds of some 30 plants obtained from Thompson and Morgan, England have been introduced in this region, and the methods of propagation, manuring, time of sowing and the optimum conditions of growth and development of successfully cultivated plants were studied. The plants are as follows:

(i) *Origanum majorana;*

(ii) *Rosmarinus officinalis;*

(iii) *Ricinus communis;*

(a) Var. *cambodgensis*

(b) Var. *gibsonii*

(c) Var. *Zanzibarensis*

(iv) *Santolina chamaecyparissus*

Project Associate: S. M. A. Kazmi.

(b) TRANSPLANTATION OF ATROPA BELLADONNA L. AND DIGITALIS PURPUREA: Both the plants have been successfully cultivated on a semi-commercial scale. Transplantation of the drugs has been carried out and the present growth promises to yield a good crop. Chemical examination of the alkaloidal content of *Atropa belladonna* and the glycoside content of *Digitalis purpurea* in the harvested crop will show how far their cultivation in this region will give an economic return.

Project Associates: S. M. A. Kazmi and M. A. H. Afandi.

(6) MANURIAL TRIALS OF HYOSCYAMUS MUTICUS LINN: Manurial trials to obtained optimum vegetative growth on *Hyoscyamus muticus* Linn have been completed.

The plants were harvested at the flowering stage, and roots, stems and leaves were dried and weighed separately. The yield in some cases was found to be almost four to six times higher as compared with the cont-

rol. The effect of K, N and P in varying nutrient mixtures has been studied, and the combination of KNO_3 and superphosphate gave a considerable increase in the total alkaloidal yield and the total yield of the plant. The results will soon be sent for publication.

Project Associate: S. M. A. Kazmi.

(7) A Study of the Action of Chaksine and iso-chaksine on Ileum of Guineapig: In addition to the earlier findings with chaksine and *iso*-chaksine on guinea pig ileum the results of which have been sent for publication, it was found that the two drugs were ganglion blocking agents. Further work on *iso*-chaksine is continuing to determine as to whether the drug was effective on the nervous tissue receptors, or the smooth muscle receptors or both.

Project Associates: A. Q. S. Bukhari and Inayat Khan.

(8) Hypotensive Effects of Chaksine and iso-chaksine: To evade hypotensive effects of chaksine and *iso*-chaksine, investigations in respect of dog blood pressure and respiration are going apace. Actions of *Rhazia stricta* extract are also being determined. The initial results obtained are promising.

Project Associates: Inayat Khan and Mujahid Hussain.

(9) Tests for Anti-kinin Activity: Due to a temporary non-availability of chandnine and harmidine it was thought worthwhile to prepare samples of kinin, so that when further supplies of alkaloids become available tests for their anti-kinin activity could be pursued. The venom of *Vespa orientalis* was collected and examined. The initial findings show the presence of little if any histamine and little or no acetylcholine. Most of the activity seemed to be associated with a material which acted on most tissues in the same way as 5-hydroxytryptamine. However, the effect of 5-HT and wasp venom on the dog's blood pressure were shown to be different. Further work is in progress:

Project Associate: G. A. Mogey.

FRUIT TECHNOLOGY

(1) New Fruit Products from Guava: 'Guava', botanically known as *Psidium guyava* L., is abundantly available throughout the year, yet it finds a limited use in the food industry for preparation of Jelly etc. The fruit, and particularly its skin, is a rich source of vitamin C. The work carried out at these laboratories indicates the possibility of preparing two new products—Guava Squash and Guava Nectar. Trials are underway for pilot production of the products. A paper on the preliminary finding has been sent for publication.

Project Associates: N. A. Sufi and M. B. Bhatti.

(2) Chemical Composition and Preservation of Sour Oranges: Investigations were carried out to study the component of sour oranges and exploring possibilities for producing new fruit products. The peel, pulp and juice of the fruit have been examined and it is found that: (i) ash content of peel is higher than the pulp or juice; (ii) iron and phosphorus contents are higher in pulp, less in the juice and least in the peel (iii) acid content and sugars (reducing and non-reducing) are higher in the juice than in the pulp, and least in the peel (iv) vitamin C is maximum in the peel and juice; and that (v) the acceptable products such as squash, marmalade and marmalade juice can be prepared satisfactorily from sour oranges. The results are being sent for publication.

Project Associates: M. I. Khattak, N. A. Sufi and M. B. Bhatti.

(3) Standardization of a Process for the Production of Strawberry Cordial: Strawberry grown in the garden of North Regional Laboratories, was subjected to processing trials for the production of strawberry cordial. Four processing trials were conducted and the data on percentage weight of end product, percentage loss of syrup and percentage juice extractable were recorded. Further investigations are in progress.

Project Associates: A. Sattar and M. B. Bhatti.

MINERALOGICAL RESEARCH

(1) Occurence of Silver in Galena: Samples of galena were procured from different localities in West Pakistan and their silver contents determined. The determination of silver in microgram amounts in the presence of large amount of interfering elements is rather difficult and, hence, the factors influencing the colorimetric method of determination of silver using *p*-diethylaminobenzylidenerhodanine has been studied in detail, both by the direct and indirect methods. The silver content in Pakistani galena has been found to range from 0.003 % to 0.096%.

Publication: 'Colorimetric Determination of Silver in Galena with Diethylaminobenzylidenerhodanine by Nabi Bukhsh and Akram Khattak. *Pak. J. Sci. Ind. Research*, **5**, 86 (1962).

(2) Studies on Rock Salt and Manufacture of Table Salt: The local brands of table salt do not conform to the specifications in chemical and free-flowing properties. The feasibility of preparing free-flowing table salts from indigenous rock salts by simple crystallization and coating the crystals with 1% of calcium or magnesium carbonate has been investigated. The chemical compositions of the raw materials and the prepared table salt, along with those of local and foreign brands have been determined. The grain sizes of different varieties have also been compared.

Publication: 'Manufacture of Table Salt from Rock Salts' by Nabi Bukhsh and Fazal Muhammad, *Pak. J. Sci. Ind. Research*, **5**, 178 (1962).

(3) Greensand: (a) Radioactivity: Large deposits of glauconite, commercially known as Greensand, have been reported to occur in Kalabagh by Geological Survey of Pakistan, and several samples have been received for investigation through their courtesy. The study of the samples has revealed that the samples are only slightly radioactive. Since all sources of radioactivity need a proper investigation, it was considered worthwhile to go into further details about the sources and cause of the radioactivity in Greensand.

Publication: 'Radio-Activity of Greensand from Chichali Pass Area of Kalabagh District (Mianwali), by M. Nabi Bukhsh. *Pak. J. Sci. Ind. Research*, **5**, 48 (1962).

(b) COMMERCIAL EXPLOITATION AS POTASSIC FERTILIZER AND AS WATER SOFENING AGENT: Some interesting studies were carried out on the samples of Greensand to establish their chemical nature. Alkali contents of the sand were also determined by J. Lawrence method. Their composition and potash contents agree fairly well with the figures of Greensand available elsewhere in the world.

Attempts to extract potash contents (varying from 2 to 5%) economically by various mixtures of flux and by using a suitable one fired at a temperature of 850-900°C from the Greensand has resulted in recovery of potash up to 90%.

The waste left after extraction of potash has the composition similar to Portland cement. Further studies on the production of cement from these sands are likely to be undertaken.

As a natural silicate Greensand possesses an appreciable capacity of Ion-exchange (about 20 milli-equivalents per 100 gm. of sample). Experiments have shown that one ton of the material has the inherent value to soften more than seven thousand gallons of ordinary hard water (hardness of more than 250 ppm. of $CaCO_3$) in one operation and the material can be regenerated.

Project Associates: Nabi Bukhsh, Mushtaq Hussain and Amin Khan.

(4) SOAPSTONE AS A GLAZING MATERIAL FOR PAPER: The Nowshera Paper Factory had to depend on the imported China clay for use as a paper filler. The problem was referred to these laboratories by the factory to find a substitute for China clay, which they had to import in large amounts. Physical and chemical characteristics of a number of samples of soapstone were determined to evaluate their efficiency for use in place of the China clay. The studies have borne fruit and China clay has been substantially replaced by indigenous soapstone.

Project Associates: Nabi Bukhsh and M. Yunis.

(5) MANGANESE ORES: Samples of manganese ores from Lasbella area have been under investigation. The nature of the mineral in the ore was found to be a silicate, rather than the usual manganese dioxide (pyrolusite). A simple method for extraction of manganese from low grade ore is under investigation.

Project Assoctates: Nabi Bukhsh and M. A. Khattak.

(6) STUDY OF LATERITES: Experiments were conducted to extract the alumina in a form suitable for use in the electrolytic reduction for the production of aluminium from a batch of laterite samples received from the Geological Survey of Pakistan. The process is ready for taking to pilot plant studies. A paper has been sent for publication.

Further work on (a) utilization of residue left after Al_2O_3 extraction as an H_2S absorbant, (b) preparation of compounds of technical importance from $Al(OH)_3$ extracted from the laterite, and (c) extraction of iron from the laterite residue, is in progress.

Project Associates: Nabi Bukhsh, Fazal Mohammad and Bashir Hussain.

(7) ION-EXCHANGE CHROMATOGRAPHY OF CALCIUM, MAGNESIUM AND IRON: For evolving a simple method for the estimation of calcium and magnesium by the classical volumetric and gravimetric methods in the silicate analysis, Amberlite IR 120 was used. Useful results have been obtained on the separation of alkaline earths and their subsequent volumetric estimation by E.D.T.A.

Project Associates: Nabi Bukhsh and M. A. Khattak.

(8) STUDIES ON SILICO-MOLYBDATE COMPLEX: In order to develop a reliable spectrophotometric method for the determination of silica in natural silicates, the reaction mechanism of heteropolyc silicomolybdic acid was studied in detail and factors influencing the stability of the complex have been determined. A paper has been sent for publication.

Project Associates: Nabi Bukhsh and Alaudin.

(9) MINERAL MUSEUM: In addition to the several samples reported in the last Biennial Report, 19 more samples were collected from Hazara region and placed in the museum. Minerals like Rhodonite, Biotite, Peridot and chryostite have been identified and labelled.

Project Associates: Fazal Mohammad, M. Hussain and Nabi Bukhsh.

(10) KYANITE AND REFRACTORIES: Chemical investigations have been carried out on samples of chromite, graphite and kyanite,

which are abundantly available in the country. In kyanite the percentage of alumina is sufficient to make it eligible for use in refractory bricks. Moulds have been prepared and the grogs were utilized for the preparation of the experimental bricks. In the mean time preliminary work of grinding, sieving etc. has been done and the bricks having different compositions were studied to determine their shrinkages. Further work is in progress.

Project Associates: M. A. K. Yusufi and Mohammad Hussain.

(11) Development of Hard, Mild and Soft Abrasive Materials from Sand, Garnet, Quartz, Talc etc.: The abrasive sand (a mixture of many associate minerals), discovered on the bank of the Kabul river near Dawal, was put under the optical investigation and minerals like calcite, rose quartz and ilmenite were separated by physical processes. The granulometric studies and the chemical investigation of 12 fractions have been done to find out the concentration of elements and their association in the sand. Experiments are being done to establish abrasivity of the material. Further work will be carried out at a later stage.

Project Associates: M. A. K. Yusufi and Mushtaq Hussain.

(12) Development of Embedding Material for the Metallurgical Mounts: Different indigenous compounds are being tried to replace the foreign embedding materials like 'Araldit' and Lakeside cement 70. Some success has been achieved in the case of plastic embedding material and with Gum Arabic. Further studies with regard to determination of shrinkage, solidification and transperancy are in progress.

Project Associates: M. A. K. Yusufi and Alizaman.

WOOL RESEARCH

(1) KAGHANI WOOL: (a) STANDARDIZATION: In order to standardize Kaghani wool for the manufacture of carpet or apparel cloth, investigations have been continued on 56 samples, and observations on medullation, fibre length and fibre diameter were recorded on true, heterotypical and medullated types. Average fibre diameter of the wool and the skirting wool have been recorded in 50 samples. The Kaghani wool is found suitable for the manufacture of medium to coarse quality cloth. A paper has been sent for publication.

Project Associates: Arbab Abdul Wakil and Mumtaz Ahmad.

(b) DISTRIBUTION AND MEASUREMENT OF MEDULLATION: For the purposes of manufacture it is desirable that the Kaghani wool fibres are free from medullation or hairiness as far as possible. The presence of medullation in Kaghani wool fibres is detrimental to the interest of the manufacturer. A comparative study of the Kaghani wool fibres was undertaken, and the measurements have been confined to 48 wool samples taken from the sides of the body of the Kaghani sheep. Tests were carried out mostly on those samples which have a greater percentage of medullated fibres. The percentage of true, heterotypical, medullated and kempy fibres in 0.6 g. sample has been found. The percentage of kempy fibres was found to be negligible. Since the degree of medullation is an important factor to be considered by sheep breeders, spinners and dyers, studies on fragmental, interrupted and continuous medullation have been undertaken. A paper is being sent for publication.

(2) STANDARDIZATION OF HASTNAGRI WOOL FOR CARPET MANUFACTURE: Full fleeces of wool obtained from Hastnagri sheep were studied. About 25000 fibres were tested for coverage fibre diameter; 31000 for percentage proportion of four types of fibres, viz. true, heterotypical, medullated and kemp; and 12000 for fibre diameters as well as fibre lengths of the four types of fibres. Results obtained were standardized against the available standards for an ideal carpet wool. It has been found that the wool meets all the requirements of an ideal carpet wool. Measures have been suggested for eliminating the high coefficients of variation of the said proportion and dimensions.

Publication: 'Characteristics of Hastnagri Wool and its Standardization for Carpet Manufacture' by Maqsood A. S. Syed, *Pak. J. Sci. Ind. Research*, **5**, 104 (1962).

(3) Physico-Chemical Studies on Wool Grease: Investigations on 16 samples of Kaghani and Hastnagri wool for the extraction of wool grease (lanolin) have been carried out. These studies have indicated that the grease content in both the varieties is considerably low and, therefore, an economical extraction is not feasible.

Project Associates: Arbab Abdul Wakil, Maqsood Ali Shah and Mumtaz Ahmad.

(4) Characteristics of Harnai Wool Fibres: The characteristics of Harnai wool fibres, of which 90 samples were obtained from Quetta and Qalat Divisions, have been studied by subjecting the fibres to the hydraulic type single fibre testing machine. The breaking strength and elongation have been determined, and stress, tenacity and tensile strength have been calculated. The coefficient of correlation between diameter and breaking strength, diameter and tensile strength have been compared with the international standards. The results of these studies disclose that since the three types of Harnai wool fibres conform to the minimum requirement of 25% elongation, they may be regarded as suitable for weaving medium quality apparel cloth. A paper has been sent for publication.

Project Associates: Arbab Abdul Wakil and Amir Mohammad.

VI

RESEARCH SCHEMES

RESEARCH SCHEMES

1. Cultivation of *Rauwolfia serpentina* benth and (2) Large Scale Plantation of *Rauwolfia serpentina* benth: Scheme (i) was sanctioned by the Council in 1955 for a period of 1 year under Dr. S. Hedayetullah, who at the time was Liaison Officer, Ministry of Agriculture, East Pakistan, and Scheme (ii) was sanctioned in 1958 for a period of 3 years. However, since Dr. Hedayetullah has joined the East Regional Laboratories, these schemes are being treated as departmental and the work on these projects is being continued.

The experimental plots laid out to investigate the effects of different fertiliser combinations on the yield and the alkaloid contents of the roots were harvested in February 1961, when the plants were more than three years old. The yields of the root were statistically analysed and though the variations in the yield of the experimental blocks were highly significant, the variations due to use of fertilisers treatment were insignificant. The work on the alkaloidal content of these roots has been carried out at the Drugs and Pharmaceutical Division of the Central Laboratories, P.C.S.I.R.

Seven different species of Rauwolfia have been cultivated. About 250 lbs. of the roots were produced in 1961 and used for preparation of 'Serpajmaline' for clinical studies.

3. Utilisation of Jute and Jute Wastes: The work on this project is being carried out under the supervision of Dr. M. H. Khundkar, Professor of Chemistry, University of Dacca. A few promising results have been obtained during the years under review. A method for using jute (or jute waste) for preparation of carboxymethylcellulose (CMC), which can be employed as a detergent extender or as a sizing material in paper and textiles, has been developed. It has also been possible to prepare a non-toxic (clinical) grade CMC which can be used in food and pharmaceutical industry as a thickening and emulsifying agent. It has been found that jute stalk is a rich source of furfural and work on solvent extraction of furfural has given encouraging results.

4. Basic Biological Research on Chlorinated Insecticides: This scheme has been sanctioned under the sponsorship of Dr. M.A.H. Qadri, at the Karachi University for a period of 3 years. The scope of

this work will be limited to the following investigations. (i) How and where the storage of chlorinated insecticides takes place in insect tissues. (ii) How and through what agencies the toxin is excreted from insect bodies. (iii) What is the intermediate metabolism of chlorinated products in insect tissues (iv) To which system toxins just by-pass without affecting it. (v) What kind of behaviour or structural changes are brought about by the toxin in insects.

5. Preparation of Adenosine Triphosphate and Coenzyme I: This scheme has been sanctioned under the sponsorship of Dr. Mansoorul Hassan Alvi of Khyber Medical College, Peshawar.

In most of the *in vitro* enzyme systems, several co-factors are required. Some of the most important co-factors, which act as sources of energy, are Adenosine triphosphate, Uridine triphosphate and other similar compounds or those which act as electron carriers in the oxidative system such as Diphosphyridine nucleotide (coenzyme I), coenzyme II, cytochromes and others. These co-factors not only provide energy for the endergonic biochemical reactions but also maintain the integrity and permeability of the microscopic and submicroscopic cellular particles. Use of these co-factors is wide-spread not only in biochemical research but even in diagnostic procedures. The first phase of the project would be limited to the preparation of Adenosine triphosphate and coenzyme I.

6. Preparation of Insulin from the Slaughter House Animals: This scheme has also been sanctioned under the sponsorship of Dr. Mansoorul Hassan Alvi of Khyber Medical College, Peshawar. Under this scheme, it is proposed to prepare insulin from slaughter house pancreatic tissue and establish suitable experimental conditions for pilot production. Studies on (i) chromatographic separation of insulin, (ii) methods for biological assay of insulin; and (iii) the activity of insulin from different species, will also be carried out.

VII

INTERNATIONAL ASSISTANCE PROGRAMME

INTERNATIONAL ASSISTANCE PROGRAMME

Training Facilities: The information in regard to the training facilities is as under:

UNESCO :

Two Research Pharmacologists, who proceeded to U.K. in 1958, for advance training in their field of activity under Unesco Fellowships have returned.

Two Documentation Officers and one Photographic Officer, who proceeded on training abroad in their respective fields of activity during 1961, have since returned.

Mr. M. A. Salam, Assistant Secretary, who was sent for training in the field of Scientific Administration for a period of one year against a Unesco Fellowship has since returned.

During the year 1962, one Translating Officer of Pansdoc and one Technical Assistant of Central Laboratories, who proceeded abroad for training in the field of their activity under Unesco Fellowships, are continuing their training (Appendix 1).

F. A. O. :

Of the five candidates who continued their training in Food Technology under F.A.O. Fellowships during 1960, 4 of them have since returned and one, who was granted study leave from December, 1961, for higher studies, has also returned.

COLOMBO PLAN :

Under the Colombo Plan 34 Scholarships have been allocated to this Council for the year 1961-62. During this period 13 employees of the Council have proceeded abroad for training and 10 have returned after completion of their training (Appendix II).

FRANCE :

The 2 candidates who proceeded for training in France in 1960 have returned. One more candidate has been sent for training in France against the fellowship offered for 1961 (Appendix III).

GERMANY :

Three candidates, who proceeded to Germany in 1960, against the scholarships offered by the German Government through the Ministry of Education, have continued their training during 1961-62. One more candidate has been sent for training in Germany against the fellowship offered for 1961 (Appendix IV).

COUNCIL'S SCHEME :

Of the 13 candidates, who were under training during 1959-60, 3 candidates have returned during 1961 and the rest continued their training during 1961-62. Nine more candidates have been sent for training during 1961-62 (Appendix V).

MISCELLANEOUS :

Of the 5 employees of the Council, who were abroad for higher studies under miscellaneous facilities offered to them during 1959-60, 2 of them have since returned, and one resigned. One more employee, who proceeded to U.S.A. in 1961, has been granted study leave for higher studies.

Mr. M. K. Bhatty, S.R.O. West Regional Laboratories, Lahore has been allowed to avail of the post-doctorate fellowship offered to him by the National Research Council for one year. He proceeded on 22-10-62.

Against a fellowship of 2 years duration offered by M/s. Buxly Paints Limited, one outsider has been sent for training in Paints Technology, in U.K. during 1962. He is continuing his study.

STUDY LEAVE :

13 employees of the Council, who proceeded abroad during 1960 on study leave for higher training in their respective fields of activity, have continued their studies during 1961-62.

21 employees of the Council have also been granted study leave during the year 1961-62 (Appendix VI).

LIST OF THE FACILITIES MATERIALISED UNDER VARIOUS TRAINING PROGRAMMES DURING 1961—62

Name of the Programme	Fields	No. of Facilities
	APPENDIX I	
UNESCO	1. Oceanography	1
	2. Technical Translation	1
	Total:	2
	APPENDIX II	
COLOMBO PLAN	1. Pharmacology	1
	2. Inorganic Chemistry	2
	3. Chemical Engineering	2
	4. Food Technology	6
	5. B. Pharmacology	1
	6. Wool Technology	1
	Total:	13
	APPENDIX III	
FRENCH FELLOWSHIP	1. Chemical Engineering	1
	Total:	1
	APPENDIX IV	
GERMAN FELLOWSHIP	1. Organic Chemistry	1
	Total:	1

APPENDIX V

Name of the Programme	Fields	No. of Facilities
COUNCIL'S SCHEME	1. Chemistry	3
	2. Insecticides	1
	3. Microbiology	1
	4. Bacteriology	1
	5. Organic Chemistry	2
	6. Physics	1
	Total:	9

APPENDIX VI

STUDY LEAVE	1. Chemistry	2
	2. Organic Chemistry	1
	3. Inorganic Chemistry	2
	4. Physics	3
	5. Metallurgy	2
	6. Ceramics	2
	7. Botany	1
	8. Pharmaceutical Chemistry	1
	9. Pharmacology	1
	10. Paints Technology	1
	11. Bio-Chemistry	3
	12. Glass Technology	1
	13. Solar Energy	1
	Total:	21

VIII

SCIENTIFIC DOCUMENTATION AND PUBLICATIONS

SCIENTIFIC DOCUMENTATION

PAKISTAN NATIONAL SCIENTIFIC & TECHNICAL DOCUMENTATION CENTRE:

PANSDOC has now well passed the teething stage and is firmly established as the national centre for scientific and technical documentation. Its services are being patronized in an ever increasing measure by various research organizations and individual scientists all over the country.

EXPANSION PROGRAMME: As a result of its multifarious activities, and in order to better serve its clients, it was decided to open two Pansdoc sub-centres, at Dacca and Lahore, respectively. The sub-centres are located at the East and the West Regional Laboratories. The work of alteration and remodelling of the premises earmarked for housing these units is now well underway, and the photo-reproduction equipment to be installed has already arrived from aborad. It is expected that both these branches will go in operation during 1963.

With the setting up of these units, it would be possible for PANSDOC to have direct access to the holdings of technical literature in the libraries of Dacca and Lahore, particularly those of the universities which have fairly rich collections of back volumes of scientific periodicals. By tapping these sources, it is hoped that additional 10 to 20 per cent of the orders on PANSDOC would be procurable from within the country.

At the headquarters, the expansion programme includes installation of a complete range of photo-offset reproduction machines, with a ancillary services like type-setting, plate making, and automatic finishing such as trimming, stiching, packing, etc.

In view of the growing demand for bulk supply of microfilms and photocopies from certain quarters, PANSDOC has had to employ machines which give quick production. For this, automation is the only solution. Automatic cameras, processers, and quality control equipment have been imported and are under installation. In order to maintain uniform quality, airconditioning of the premises became absolutely necessary. A 30 ton commercial airconditioning unit has been purchased. It will go into commission shortly. The entire building originally rented for the Centre in the P.E.C.H. Society has been turned over to the Document Reproduc-

tion Department and the necessary alterations therein are being carried out. As soon as this is accomplished and the off-set presses go into operation, Pansdoc would be in a position to undertake the entire printing job of the Council's Journals, Reports, etc., in addition to its own specialized bibliographical publications and abstract periodicals.

The office of the Head of PANSDOC, Administration Branch, the entire Documentation and Translation Departments and the Library have been shifted to another building close by, which has been rented for the purpose.

UNESCO Aid: During the period under review, the UNESCO aid to the PANSDOC Project has been on the wane. Mr. A. L. Gardner, the Chief of the Mission, left PANSDOC in May, 1961, on termination of his assignment, and proceeded to Bangkok to set up a similar UNESCO Aided Documentation Centre in Thailand. Later, at the end of August, 1961, Mrs. D. Loman, Adviser in Translation Services, finally left for the United Kingdom. Mr. M. J. O'Halloran, Document Reproduction Adviser continued till the end of December, 1962, when he proceeded to join Mr. Gardner at Bangkok. With the withdrawal of the UNESCO Advisers, complete responsibility for the operational side of the technical services fell on the Pakistani staff.

UNESCO Fellowships: On a UNESCO Fellowship Dr. A. R. Mohajir proceeded to U.K. and the Continent in April, 1961 to study the scientific documentation services there. On his return he has prepared a comprehensive report entitled: "Documentation and Information Centres: U.K., Western Europe, U.A.R. (Apr.-Oct. 1961)" ix, 335 pp., on this tour, which has been published for dissemination.

Three other staff members were awarded UNESCO Fellowships during this period. Mr. Akhtar H. Siddiqui, Documentation Officer, proceeded for training in documentation techniques, in the U.K. and some countries of Western Europe (Sept., 1961 – April, 1962); Mr. Sanaul Haq, Junior Photographic Officer (now Photographic Officer), went for training in document reproduction techniques in the U.K. and Western Europe (January, 1961 – January 1962); while Mr. Nasirud Din Humayun, Translating Officer, has proceeded to U.K. in September 1962, on a similar fellowship for six months, in order to acquire advanced techniques in translation from Russian, Byelorussian, Ukrainian and Bulgarian, under the experts in these languages at the D.S.I.R. National Lending Library for Science and Technology, Boston Spa, Yorkshire.

PANSDOC Symposium: All technical documentation services lean heavily on the available literature resources in the country. Having started from scratch in almost all fields, Pakistan has been very deficient in respect of libraries, and most of the existing ones have not yet attained a reasonable standard. Owing to the pertinent need, to improve this state of affairs by devising ways and means of accelerating the development of scientific and technical libraries and information services in Pakistan on proper and rational lines, PANSDOC has undertaken to hold a symposium on "The Development of Scientific and Technical Libraries in Pakistan". This proposal has been very well received by all concerned. Preliminary spadework in connection with the conference is now well advanced and invitations have already been extended to over 50 institutions to nominate their delegates. The dates for the symposium have been tentatively fixed for mid-March, 1963. The National Science Council have offered the use of their premises for holding the conference, while the Asia Foundation has promised to defray travel expenses of some of the delegates.

Training Facilities: Six years of experience, foreign trained staff, and the most modern document reproduction equipment in operation, have put the Pansdoc in a position to offer excellent training facilities, both theoritical and practical, covering all phases of documentation work, to the interested organisations.

During 1961/62, this facility has been availed of by three institutions, namely, (1) The Dacca University, (2) The Directorate of Archieves and Libraries, Ministry of Education, Government of Pakistan, and (3) The Geological Survey of Pakistan. These organizations have set up their own microfilming units and each deputed the technical assistant selected to operate the equipment for short-term intensive training at Pansdoc. This included a thorough grounding in the techniques of microfilming, film processing, photo-printing and general photo-finishing, together with a short briefing in photo-office administrative and supply procedures.

The University of Karachi has instituted a post-graduate degree in library science, including documentation and photo-reproduction methods in the syllabus of courses. PANSDOC has acceded to the request of the university authorities in extending its cooperation for imparting theoritical as well as practical training in documentation techniques to the M.A. final classes. Under this arrangement, the first batch of 15 post-graduate students is now receiving instruction at PANSDOC since September, 1962.

Other Asian countries have also started taking advantage of this facility. The Thai National Documentation Centre to which a reference

has been made earlier, has requested for one of their documentation officers to be given short-term training in documentation techniques at PANSDOC. Their nominee, Mr. Pun Udom, is scheduled to arrive in Karachi in January 1963 for a 4-month training for this purpose.

Two Heads of National Documentation Centres, viz. those of the Philippines and Indonesia respectively, paid brief visits during the period under review, in order to study the organisational set-up of the PANSDOC.

PANSDOC SERVICES

During the period under review, Pansdoc handled orders for photocopies, microfilms, bibliographies and translations, as usual and their numbers are given in Table I. The service output for 1962 was somewhat less than for 1961, as document reproduction equipment had to remain idle on several occasions on account of heavy alterations, etc. to the premises.

Document Procurement Section: The total number of orders for all categories of services handled by this Section during 1961/62 was 4568. The service-wise breakup of these orders is as follows:

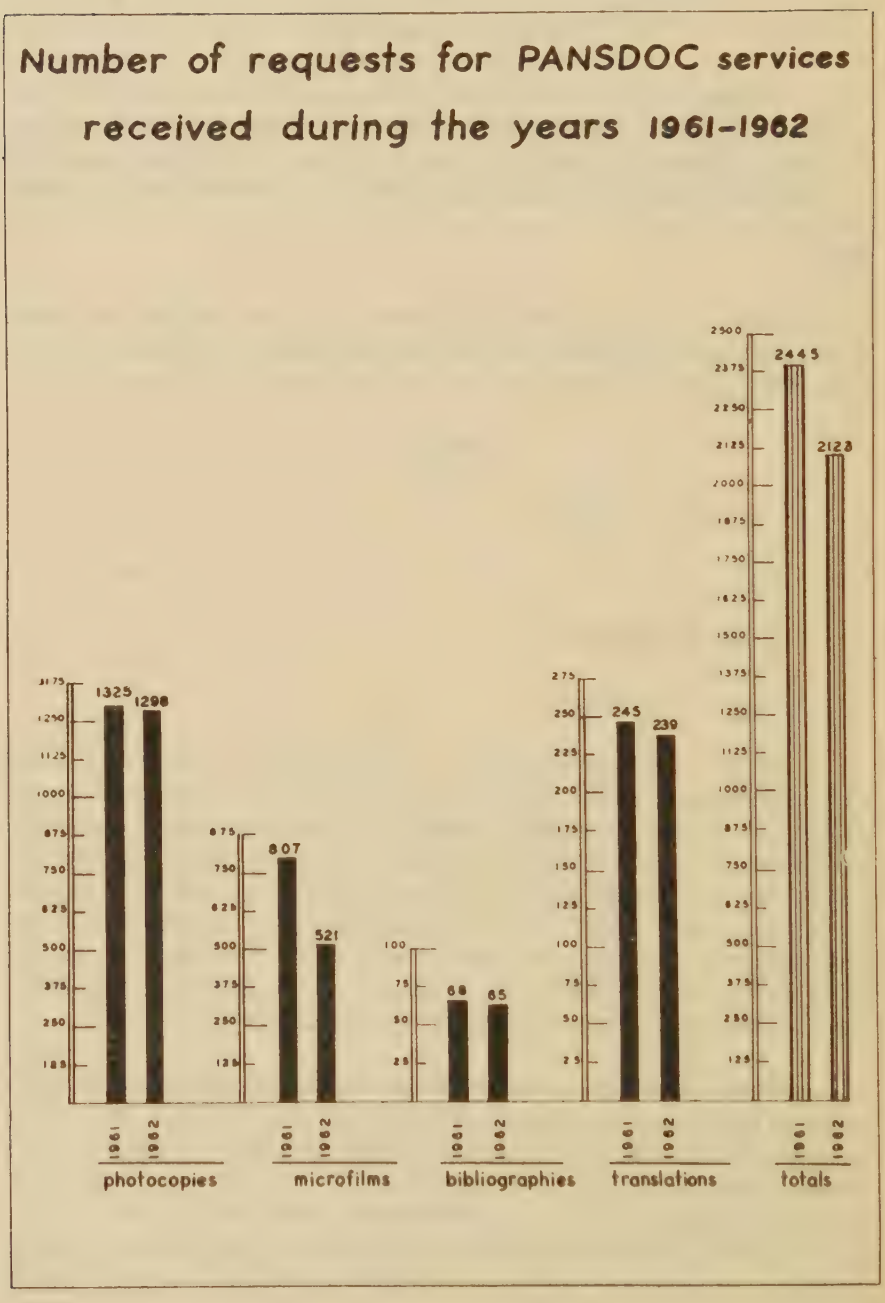
TABLE I

(i)	Photocopies	2623
(ii)	Microfilms	1328
(iii)	Bibliographies	133
(iv)	Translations	484

It will not be out of place to mention here that the bulk of orders for photocopies or microfilms of documents have to be referred to foreign sources for supply. This often results in an inordinate delay causing inconvenience to clients. This state of affairs cannot be helped and the only remedy lies in developing our own libraries on proper and rational lines. So far only about 20-25% of the orders could be procured locally, but with setting up of Dacca and Lahore branch units, this figure is expected to go up by another 10-20%, i.e., a total of about 30-40% orders, affecting a slight over-all improvement in the time-factor.

Bibliography Section: There has been a continuing demand for supply of bibliographies on specialised topics, and a total of 133 such bibliographies were compiled to client's orders (for list see Appendix C). These contained a total of 1,611 separate references. Two specialised bibliographies were also issued in mimcographed form, on its own initiative by PANSDOC, for wider distribution. These were (i) "Peat utilization" (*Pansdoc Bibl.* No. 277) containing 261 references, and (ii) "List of scientific

TABLE I


Number of requests for PANSDOC services received during the years 1961-1962
1325
1298
807
521
68
65
245
239
2445
2123
1961
1962
photocopies
microfilms
bibliographies
translations
totals

and technical periodicals of Pakistan" (*Pansdoc Bibl.* No. 303). The latter bibliography has been in considerable demand particularly from other countries.

PAKISTAN SCIENCE ABSTRACTS: Pansdoc inaugurated in 1961 a quarterly bibliographic index entitled: "Pakistan Scientific Literature: Current Bibliography", listing tables of contents to the leading scientific and technical periodicals of Pakistan. Its issues Nos. 1, 2, & 3/4 were brought out during 1961. From 1962, this has been converted into a regular abstract service with the new title: "Pakistan Science Abstracts". It is being circulated to 108 domestic and 53 foreign organizations. This periodical has enabled Pansdoc to initiate independent exchange relations with institutions in other countries having similar material to offer, and these exchanges are being widened.

TRANSLATION SECTION: This Section received during the period 484 requests for translations (1500 foolscap typed pages). As usual the languages mostly in demand were: German, French, Russian, Italian, Japanese, and Spanish, in that order.

A periodical list of PANSDOC translation is given in Appendix C. Six monthly lists of the translations made are circulated to all concerned, including the ASLIB in U.K. for notices in the "Commonwealth Index of Translations".

PANSDOC now has on its staff three full-time Translating Officers, two multilingual with foreign training, who are able to tackle nearly half a dozen languages between them. In view, however, of the heavy demand on this service and the range of languages to be covered, the present staff cannot possibly handle all the work by themselves. A suitable panel of translators has accordingly been created from foreign nationals and Pakistanis with adequate language ability who are prepared to undertake translations as spare time work. Efforts are continuing to recruit more staff translators of the requisite ability. The load on this section, however, continues to be the heaviest.

DOCUMENT REPRODUCTION SECTION: A reference has already been made above to the fact that the premises housing this Section are undergoing heavy alterations and remodelling since October, 1962. The work is

expected to be finished by the middle of 1963. As a consequence of this most of the equipment has been dislocated, resulting in partial stoppage of work for sometime. The total number of photo-reproductions prepared in this section was 3,951 (Table I).

PUBLICATIONS

PAKISTAN JOURNAL OF SCIENTIFIC AND INDUSTRIAL RESEARCH:

A very important sector of the Council's activities is the publication of the researches, both fundamental and applied, carried out in its laboratories. Most of these are now being published in the *Pakistan Journal of Scientific and Industrial Research*, which is regularly making appearance as a quarterly since January, 1958.

The eight issues of the Journal printed during 1961 and 1962 contained a total of 580 pages, which comprise 120 original research papers including short communications that cover 515 pages. Besides, three features, namely, Notes and News, Patents Abstracts and Book Notices comprising 33 pages and two special articles and addresses covering 32 pages were also published.

Of these eight issues, the October 1961 issue of the Journal needs special mention. This was a Special Number on the International Symposium on Plant Resources of the Middle East and Rauwolfia for the Pharmaceutical Industry, which was held in December 1960 at Peshawar under the joint auspices of the UNESCO, the Pakistan Council of Scientific and Industrial Research and the Pakistan Association for the Advancement of Science. The special number contained the adresses delivered at the symposium and 22 research papers which were submitted for publication. It conveys some idea of the problems involved in the subject matter of the symposium.

After the issue of January, 1962, the regular feature 'Notes and News' was discontinued in this Journal, as it was considered that the same would be better placed in '*Science Chronicle*', a popular monthly journal of the Council which caters for the general public.

ANALYSIS OF RESEARCH PAPERS: Although the bulk of the contributions still emanates from the Council's laboratories, a sizable proportion is contributed by other research and technological laboratories in the Universities, Government Departments and Industrial Organizations. The yearly distribution of the papers by laboratories is given in the following table.

DISTRIBUTION OF PAPERS BY LABORATORIES

	1961	1962	Total
Central Laboratories	11	21	32
East Regional Laboratories	5	14	19
West Regional Laboratories	2	4	6
North Regional Laboratories... ..	4	10	14
Other Laboratories	30	18	48

This table shows that the contributions of the Regional Laboratories of the P. C. S. I. R. are increasing steadily in consonance with their development. It also shows that about two-fifths of the papers have been contributed by laboratories other than those of the P. C. S. I. R. There is a rather large increase in the contributions of the other laboratories during the year 1961 due to the Special Number which was entirely devoted to the above-mentioned Peshawar symposium.

A subject-wise analysis of the papers published during the two years is given in the table below, and it shows a fairly even distribution between the fields of chemical, biological and physical sciences:

ANALYSIS OF PAPERS BY SUBJECTS

	1961	1962	Total
Plant Products and Organic Chemistry	39	18	57
Biochemical and Biological Sciences	6	27	33
Physics and Physical Chemistry	4	11	15
Oils, Fats, Paints and Plastics	4	3	7
Building Materials, Chemical Engineering and Inorganic Chemistry	7	7	14

The journal commands a good circulation (about 1,000 copies) and is sent to various institutions and libraries in 42 countries, 270 periodicals being received in exchange. Receipts through advertisements and subscriptions during the years 1961 and 1962 have grossed Rs. 11,400, which makes a total of Rs. 27,512 since the inception of the Journal in January 1958.

Science Chronicle:

Since September, 1962, a popular science monthly magazine in English '*Science Chronicle*' has been brought out. It was felt that the phenomenal progress that science is now making in all spheres cannot possibly realise its broad objectives, unless the interest of the common man is awakened in science and its inevitable impact on society. The progress in scientific pursuits has reached a stage where it cannot afford to limit itself to a narrow corner. Popularisation of science is of vital importance in the scheme of things in the latter half of the twentieth century. '*Science Chronicle*' has made its appearance to fill this gap as far as possible.

The magazine publishes popular articles on scientific subjects contributed by the scientists of the country as well as material received from eminent scientists and science feature writers from aboard. Significant news from the world of science is also projected through this publication.

'Science & Industry' and Journals in Bengali and Urdu:

In order to highlight the impact of science and technology on the economy of the country, it was decided sometime in June 1962 to bring out a new publication '*Science & Industry*' on a quarterly basis in addition to the two publications mentioned above. The first issue of this journal is expected to come out during early next year.

It has also been decided by the Council to make a start with the publication of journals of popular science in Bengali and Urdu for creating public interest in science on a broader level. Arrangements are under way to publish journals as early as possible.

MISCELLANEOUS PUBLICATIONS

Ali, S. Asad Maqsood., Rizvi, S. Baqar., Hasan, S. Zafrul and Mahdihassan, S. 'Bazar Medicines of Karachi: Fresh Herbs'. *Medicus*, **21**, 264 (1961).

Ali, S. Asad Maqsood., Tasnif, M., Hasan, S. Zafrul and Mahdihassan, S. 'Drugs of Pavement Herbalists': *Medicus*, **23**, 24 (1961).

Ali, S. Asad Maqsood and Mahdihassan. 'Drugs of Animal Origin'. *Medicus*, **23**, 72 (1961).

Ali, S. Asad Maqsood and Mahdihassan, S. 'Inorganic Drugs' *Medicus*, **23**, 125 (1961).

Mahdihassan, S. 'Kekule's Dream of the Ouroborous and the Significance of this Symbol'. *Scientia*, **55**, 187 (1961).

Mahdihassan, S. 'Alchemy in the Light of its Names in Arabic, Sanskrit and Greek'. *Janus*, **49**, 79 (1961).

Mahdihassan, S. 'Alchemy: its Three Important Terms and Their Significance'. *Med. J. Australia*, **55**, 227 (1961).

Mahdihassan, S. 'Elixir, its Significance and its Origin'. *J. Asiatic Soc. Pakistan, Dacca*, **6**, 39 (1961).

Mahdihassan, S. 'Der Chino-arabische Unsprung des words Chemicka'. *Pharm. Ind.*, **23**, 515 (1961).

Mahdihassan, S. 'A Survey of Lac Production Particularly in Sind'. *Pak. J. Forestry*, **23**, 78 (1961).

Mahdihassan, S. 'Waxes of Lac Insect and Their Glands'. *Zeit. ang. Entom.*, **48**, 433 (1961).

Mahdihassan, S. '*Lakshadia Nagoliensis* as compared with *L. Communis*.' *Zool. Anzg.* **167**, 115 (1961).

Ali, S. Asad Maqsood and Mahdihassan, S. 'Vegetable Drugs in Stock of Herbalists.' *Medicus*, 243, (1962).

Bakht, Hakim S. Jamshed and Mahdihassan, S. 'Calcined Metals or kuṣtas.' *Medicus*, **24**, 117 (1962).

Haque, Sanul. Ali, S. Asad Maqsood., Hussain, Ashfaq and Mahdihassan, S. 'Pavement Pharmacy in Karachi'. *Medicus*, **24,** 220 (1962).

Mahdihassan, S. 'Salvaged Proteins For Pakistan'. IPFC (Current Affairs) Btn. of FAO., Bangkok, **35,** 12 (1962).

Mahdihassan, S. 'Uber Einige Symbols der Alchemie.' *Pharm. Ind.* **24,** 41 (1962).

Mahdihassan, S. 'Symbolism in Alchemy, Islamic and Others'. *Islamic Culture*, Hyderabad (Dn.) **1,** 20 (1962).

Mahdihassan, S. 'Alchemy in the Light of Jung's Psychology and of Dualism.' *Pak. Philos. J.*, **5,** 95 (1962).

Mahdihassan, S. 'Was ist eigentlich Alchemic.' *Deutsch Apoth Zeitz.* **102,** 512 (1962).

Mahdihassan, S. 'What is Alchemy'. *Sci. Chronicle*, **1,** 18 (1962).

Mahdihassan, S. 'A Rational Interpretation of the Four Cosmic Elements Operating in Alchemy'. *Inst. Hist. Medicine*, (Hamdard) Delhi, 184 (1962).

Mahdihassan, S. 'Kimiya and Aksir'. *Lab. Bkn.* (May and Baker), **5,** 38 (1962).

Mahdihassan, S. 'Philospher's Stone and its Original Conception'. *J. As. Soc. Pak.* Dacca, **7,** 263 (1962).

Mahdihassan, S. 'Pakistan Pharmaceutical Industry-Present and Future'. *Trade and Industry* (Kar), 512 (1962)

Zaidi, S.A.H., Husain, S. Ashfaq and Mahdihassan, S. 'Future Studies on Iron-Carbohydrate Complexes'. *Arzneimittel-Forsch*, **12,** 52 (1962).

IX

PATENTS AND RESEARCH UTILIZATION

PATENTS

During the period under review, 11 patents have been obtained in Pakistan, and patent applications for 2 inventions have been accepted in 6 foreign countries. At the end of 1962, 4 patent applications were awaiting action in the Pakistan Patent Office. A list of all these patents and patent applications is given below.

A. PATENTS ACCEPTED DURING THE YEARS 1961 AND 1962

A process for the preparation of a brazing flux for use at high temperatures. A. H. M. Z. Haq, M. G. A. Biswas and Karimullah. Pakistan Patent 110765, April 4, 1960.

A process for the production of rosin esters of betulin, and coating compositions prepared therefrom. S. Siddiqui, M. Aslam and K. Alam. Pakistan Patent 110806, September 27, 1960.

A method for the clarification of cane molasses for use in the manufacture of yeast. A. F. M. Ehtashamuddin, M. Saeed and Karimullah. Pakistan Patent 110912, April 4, 1960.

A wax emulsion for water-resistant treatment of textiles. Ehsan Ali, M. H. Hashmi and Karimullah, Pakistan Patent 111634 December 15, 1961.

A process for the production of lightweight cellular clay bricks. S. Tehzibul Hasan, M. Aslam, R. A. Shah and H. Imam. Pakistan Patent 111852, January 25, 1961.

A process for the production of artificial marble. M. Aslam, S. Tehzibul Hasan, R. A. Shah and K. N. Zaidi. Pakistan Patent 112179, March 19, 1962. (Applications pending in other countries).

A process for the production of dry distempers. M. Aslam and S. Tehzibul Hasan. Pakistan Patent 112211, June 11, 1962.

A process for the preparation of a caffeine extract for the production of carbonated beverages. M.I. Qureshi, F. H. Shah, N. Shakir, A. A.

Saddal, M. K. Bhatty and Karimullah. Pakistan Patent 112248, June 12, 1962.

A solar water heater. Ehsan Ullah Khan. Pakistan Patent 112376, December 15, 1961.

A solar drier for fruits and vegetables. Ehsan Ullah Khan. Pakistan Patent 112377, December 15, 1961.

A flue-jacketed hot roller press. A. H. Chotani and S. M. Ishaq Ali. Pakistan Patent 112381, February 28, 1962.

B. PATENT APPLICATIONS FILED IN THE PAKISTAN PATENT OFFICE

A process for silvering glass. M. Saeed, Ali Gauhar and Karimullah. Pakistan patent application No. 544/62, June 12, 1962.

A process for the isolation of an alkaloid 'harmidine' from *Peganum harmala*. S. Siddiqui. Pakistan patent application No. 560/26, June 19, 1962.

A process for the production of a foaming agent for cellular concrete. S. Siddiqui, M. Aslam and S. Tehzibul Hasan. Pakistan patent application No. 759/62, August 17, 1962.

A process for the production of a dry foaming agent for cellular concrete. S. Siddiqui, M. Aslam and S. Tehzibul Hasan. Pakistan patent application No. 1064/62, November 17, 1962.

C. PATENTS ACCEPTED IN FOREIGN COUNTRIES DURING 1961 AND 1962

A process for the production of metallic iron from low grade ferrogenous clay containing iron ores. G. Hahn and S. I. Ali. Australian Patent 236489, November 3, 1959; British Patent 895854, October 28, 1959; Canadian Patent 625919, December 8, 1959; Indian Patent 69523, October 29, 1959; U.S. Patent 2,991,172 October 26, 1959.

A process for the isolation of alkaloids and alkaloidal complexes from the Rauwolfia species of plants. S. Siddiqui. Swiss Patent 362698, January 9, 1958; U.S. Patents 3,047,562, and 3,047,563, July 2, 1957.

The number of patents obtained and patent applications filed in Pakistan and other countries from 1953 to 1962 is shown in the table.

Number of Patents and Patent Applications at the end of 1962

Country	Patents obtained	Applications filed	Total
Pakistan	46	4	50
Australia	7	2	9
Belgium	2	—	2
Canada	7	2	9
Denmark	—	1	1
France		1	3
Germany (West)	3	2	5
Great Britain	7	2	9
India	18	4	22
Italy	—	—	—
Japan	1	2	3
Netherlands	—	1	1
Switzerland	2	1	3
Sweden	—	1	1
U. S. A.	5	1	6

INDUSTRIAL PROCESSES DEVELOPED BY THE PAKISTAN COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

This report gives the present status of the processes which have already gone in production and also of those which are in various stages of development or nearing completion.

1. JUTOID MATTING

This is a waterproof matting based on hessian and locally available bituminous compositions, meant for roofs. More than 1,00,000 sq. ft. of the material (sale value Rs 30,000) was produced on a pilot plant scale during 1958-60. It is in commercial production at Karachi since 1960. (Messrs. Hyesons Ltd.) and the production figures are given in the following table:

Year	Sale (approximate)
1960	Rs. 1,25,000
1961	Rs. 2,37,000
1962	Rs. 5,80,000

The production was achieved with the pilot plant fabricated by P.C.S.I.R. and rented out to Messrs. Hyesons. Their new and bigger plant will go into production next year and a similar plant is to be set up at Chittagong. This process is covered by two patents, one relating to composition and the other relating to the equipment design.

Pakistan Patent Nos. 109344 and 109346 and Indian Patent Nos. 65207 and 65866.

2. PETROL GAS PLANT

This plant has been designed for meeting the requirements of schools, colleges, research laboratories and small industrial units in the country. 40 Gas Plants were produced on the pilot plant scale and sold to various institutions. The process has been in commercial production since 1961 and data for sales are given in the following table:

Year	Sale (approximate)
1961	Rs. 97,500
1962	Rs. 1,90,200

The process is covered by Pakistan Patent No. 107505.

3. CEMTO

This is an integral waterproofing composition for concrete. Over 10,000 lbs. of the product was produced on pilot plant scale and sold for consumer testing during 1959-60. For the present, the manufacturers (Messrs. Pak. Waterproofing Co.) have been using most of its output for their own requirements and have recorded a sale of only Rs 15,000 for 1962. This process has now been leased out for commercial exploitation in East Pakistan. These two units when in full operation are expected to meet the present demand for 'Cemto'. The process is covered by Pakistan Patent No. 109599.

4. PRODUCTION OF VITAMIN 'A' CONCENTRATE FROM SHARK LIVER OIL

This process was leased out in 1959, but due to difficulties in getting foreign exchange requirements, its production was delayed. However, the process is now in commercial production since October, 1962.

5. BALCRETE

Balcrete is used for the manufacture of foam concrete. Several improvements in the composition and the manufacturing techniques were made over a period of three years, with a view to bring the light weight concrete within the reach of an average consumer. The consumption of the final product is about 2-4 ozs. per bag of cement. About 50,000 lbs. of Balcrete was produced on a pilot plant and sold for consumer testing. The process went into commercial production in October 1962, and is covered by the following patents:

Pakistan Patent No. 108318 and application No. 759/62, and Indian Patent No. 60368.

The demand for 'Balcrete' increased by 100% from 1960 to 1962 and as the importance of foam concrete for thermal comfort is brought

home to consumers, this is likely to increase the demand for the product tremendously.

6. DRIED SLAUGHTER HOUSE BLOOD

Slaughter house blood is generally dried in the sun and dried product is exported. During cloudy or rainy weather, the raw material is completely wasted. A simple, small scale process for drying of slaughter house blood was, therefore, developed and put into commercial production at Lahore towards the end of 1962. If the process is adapted in all major cities of the country, it will increase the production of dried slaughter house blood by about 50%. A further advantage of the process is that the quality of the final product is superior, more uniform and, therefore, should fetch a better price in the world market. The process is covered by Pakistan Patent No. 109880.

7. CHINESE BLUE

The process was put into commercial production in 1959 and the product is available in the market.

THE FOLLOWING PROCESSES ARE IN DIFFERENT STAGES OF DEVELOPMENT:

(i) Printing Inks: This relates to compositions for rotary news ink, postal stamp-cancelling ink and duplicating ink. The process was leased out in 1959 but foreign exchange allocation has been made in 1962 and installation is expected to start on receipt of the equipment next year.

(ii) Bagasse Boards: This process, based on the utilisation of bagasse, a waste product of the sugar industry, was leased out in 1959. Foreign exchange allocation was made available only in 1962 and installation is expected to start on receipt of the equipment next year.

(iii) Fountain Pen Ink: More than five lacs was spent on the import of good quality writing inks in 1957. Since then many of the well known brands are manufactured in the country, but in all the cases, the raw materials are imported. The process developed by PCSIR requires only about 20-25% of imported materials and compares favourably with any of the imported product. This process is expected to go into production next year. The process is covered by Pakistan Patent No. 108274.

(iv) CHIPBOARDS: Chipboards are made from wood waste and a binder, which may be either a carbohydrate-modified phenolic, or urea-formaldehyde resin. The process has been leased out to two parties in 1962.

(v) FIXEMPERO: This is a dry distemper based on gypsum (to replace imported whiting) which is alkali free, rub resistant and water proof. About 10,000 lbs. have been produced on a pilot plant scale and sold for consumer testing. The process is covered by Pakistan Patent No. 112,211 (1962).

(vi) ADHESIVES FOR PACKING INDUSTRY: The varieties of starch most commonly used for good quality adhesives are tapioca sweet potato, sago, corn etc. of which tapioca is most preferred as an adhesive base, where transparency in the final product is desired. Corn starch is the only commercially available starch in the country and has been used for the process developed for manufacture of high quality adhesives for the packaging industry.

THE FOLLOWING PROCESS IS READY FOR COMMERCIAL EXPLOITATION:

(i) CUPREX: Wood preservative—a substitute for copper napthenate is under pilot production. This product can also be used as a part replacement of creosote. 4000 lbs. of the product have been manufactured on a pilot plant and sold for consumer testing. The process is covered by the following patents.

Pakistan Patent No. 108270 and Indian Patent No. 60361.

X

SCIENTIFIC AND INDUSTRIAL LIAISON

SCIENTIFIC AND INDUSTRIAL LIAISON

One of the important functions of the Pakistan Council of Scientific and Industrial Research is to serve as a medium of national and international liaison. The need for cooperation between the scientific workers of the same and allied fields is as much vital for the progress of science, as technical liaison between a research organisation and industry. Recognising the furtive spirit behind such a harmonious arrangement, the Pakistan Council of Scientific and Industrial Research has taken realistic approach to the gamut of this relationship. The problems referred to the Council by various industries can be categorized into the following two divisions in view of their distinct nature.

1. Those which require laboratory investigations to be carried out for which the minimum charge is Rs. 500.00 subject to full satisfaction of the party concerned.

2. Those who desire scientific and technical information available from local and international sources on setting up new industries, technical advice on production or quality control of a industry for which no charge is made by the Council.

Details of the problems referred to the Council in course of the two years under review are given below:

Problems completed under category I

	Name of Party	Nature of Problem
1.	Messrs. Service Industries Ltd., Karachi.	Report on Wax Emulsion for water resistance treatment and textiles.
2.	Messrs. Karachi Paint Industries, Karachi.	Report on manufacture of cement colours and Dry Colours.
3.	Messrs. Noorani Beverage Co., Hyderabad.	Report on removal of trademark from bottles.
4.	—	Method for the production of Aluminium acetate.
5.	Messrs. Manzoor Glass & Ceramics Ltd., Karachi.	Improvements in the quality of Glass products.

Some of the important problems completed under category 2

	Name of Party	Nature of Problem
1.	Ministry of Industries, Govt. of Pakistan, Rawalpindi.	Report on production of paper from rice straw.
2.	The Director General, Pakistan Post Offices, Karachi.	Report on cancellation of high denomination postage stamps.
3.	Ministry of Industries & Natural Resources, Govt. of Pakistan, Karachi.	Report on blending of oil.
4.	Ministry of Industries, Govt. of Pakistan, Karachi.	Advice on refixation of the percentage of losses in respect of the metal used in Govt. of Pakistan Presses.
5.	Ministry of Food and Agriculture, (Food Division), Govt. of Pakistan, Karachi.	Report on mass production of Tandoors—mechanical gas or oil heated.
6.	Messrs. Premier Industries, Karachi.	Advice on Castor Oil based hair oil.
7.	Ministry of Food and Agriculture, Govt. of Pakistan, Rawalpindi.	Advice on timber preservation and creosoting plant.
8.	Tariff commission, Govt. of Pakistan, Karachi.	Advice on the review of the case for protection to the indigenous soap industry.
9.	Messrs. Farokh Chemical Industries, Karachi.	Report on utilisation of Sodium silicate for treatment of concrete.
10.	Messrs. Dadabhoy Ceramic Industries Ltd., Karachi.	Advice on the feasibility of establishing sanitary factory in Karachi.
11.	Messrs. J. Rehback (Pak) Ltd.	Method for rectification of glass and nitro-cellulose.

	Name of Party	Nature of Problem
12.	Messrs. Zaheeruddin Co., Karachi.	Report on thermal conductivity for insulating concrete.
13.	Messrs. Mirpur Ceramic Works Ltd., Dacca.	Request for deputation of a technician for setting up of furnace and technical guidance complied with.
14.	Messrs. Dawood Industries Ltd.	Test report on rosin.
15.	Sidhirganj Power Station and Chittagong Diesal Power Station, EPIDC, Dacca.	Report on analysis of samples.
16.	Sidhirganj Power Station, EPIDC, Dacca.	Advice on prevention of boiler scales.
17.	East Pakistan Industrial Development Corporation, Dacca.	Report on analysis of limestone samples.
18.	Syedpur Railway Workshop, E. B. Railways, Government of East Pakistan.	Report on Furnace linings.
19.	Pakistan Tea Board.	Exhaustive report on feasibility of extraction of caffeine from tea waste and cost of the plant.

XI

APPENDICES

APPENDIX (A)

PAKISTAN COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

LIST OF MEMBERS OF THE COUNCIL

1. Minister for Industries, Government of Pakistan, President, C.S.I.R., Karachi.
2. Secretary, Ministry of Industries, Karachi.
3. Financial Adviser (Development) Ministry of Finance, Karachi.
4. Director, Council of Scientific and Industrial Research, Karachi.
5. Col. Zia-ur-Rahman, G. H. Q., Rawalpindi.
6. Chairman, Atomic Energy Commission, Ex-Officio.
7. Chairman, Pakistan Industrial Development Corporation., Karachi.
8. Mr. Nasir A. Shaikh, 5-A, Shah Din Building, The Mall, Lahore.
9. Secretary, Industries and Labour, East Pakistan, Dacca.
10. Secretary, Industries and Labour, West Pakistan, Lahore.
11. Dr. Raziuddin Siddiqui, Vice-Chancellor, Sind University, Hyderabad.
12. Dr. M. H. Khundkar, Dacca University, Dacca.
13. Mr. M. Ayub, Director, P. I. D. C., Karachi.
14. Mr. Mumtaz Hassan, Planning Commission, Karachi.
15. Secretary, Ministry of Works, Karachi.
16. Col. M. K. Afridi, Vice-Chancellor, Peshawar University, Peshawar.
17. Director, West Regional Laboratories, P.C.S.I.R., Lahore.

18. Major General Shahid Hamid, Chairman, Small Industries Corporation, Karachi.

19. Dr. A.K.M. Abdul Wahid, Adviser on Health and Medical Education, Government of East Pakistan, Dacca.

20. Director, East Regional Laboratories, P.C.S.I.R., Dacca.

21. Mr. S. Amir Chinoy, International Industries Ltd., Karachi.

LIST OF MEMBERS OF THE GOVERNING BODY

1. Minister for Industries, (Ex-Officio, President) Karachi.

2. Secretary to the Government of Pakistan, Ministry of Industries, Karachi.

3. Director, Pakistan Council of Scientific and Industrial Research, Karachi.

4. Director, East Regional Laboratories, P.C.S.I.R., Dacca.

5. Director, West Regional Laboratories, P.C.S.I.R., Lahore.

6. Director, North Regional Laboratories, P.C.S.I.R., Peshawar.

7. Financial Adviser of the Council.

APPENDIX (B)

STAFF OF THE COUNCIL'S LABORATORIES AND PANSDOC

(AS AT THE END OF 1962)

Salimuzzaman Siddiqui	F.R.S., D.Phil. Nat. D.Med. (Frankfurt a-M).	Chairman
M. Qudrat-i-Khuda	D.Sc. (London), D.I.C., M.Sc.	East Regional Director
Karimullah	D.Phil. Nat. (Heidelberg), Ph.D. (Edinburgh)	West Regional Director
S. A. Warsi	M.Sc.,Ph.D.(Pb), Ph.D. (Wales)	North Regional Director (Acting)

CENTRAL LABORATORIES

Physical Research Division

Mazhar M. Qurashi	B.A. (Hons.), M.Sc., Ph.D., D.Sc. (Manchester)., F. Inst. P. (London).	Head of Division
Ahtram Ali Khan	M. Sc., Ph. D. (London), Dip. Electronics (Southampton), D. I. C., A.M.E. Brit. I.R.E. (London)	Senior Research Officer
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MALIK KHALID MASOOD	M. Sc.	Technical Assistant (on study leave)
AZIZ AHMAD	M. Sc.	Technical Assistant (on study leave)
M. INAM KHOKHAR	M. Sc.	Technical Assistant
M. IBRAHIM BHATTY	B. Sc.	Junior Technical Assistant

Oils and Fats Division

M. K. BHATTY	Ph. D.	Senior Research Officer (on scholarship)

Iftikhar Ahmad	M. Sc.	Research Officer
M. Latif Rasulpuri	M. Sc.	Research Chemist (on scholarship)
Khalil Ahmad	M. Sc.	Research Chemist (on scholarship)
Mohammad Ilyas	M. Sc.	Research Chemist (on study leave)
Shariq Ahmad Khan	M. Sc.	Research Chemist (on scholarship)
Naeem Shakir	M. Sc.	Research Chemist
Izhar Hussain Qureshi	M. Sc.	Research Chemist (on study leave)
Akbar Saeed	M. Sc.	Technical Assistant (on study leave)
Mushtaq Ahmad	M. Sc.	Technical Assistant (on scholarship)
Naseer-ud-Din Zahid	M. Sc.	Technical Assistant
Mirza Nasir Ahmad	M. Sc.	Technical Assistant
Ehsanul Haq	M. Sc.	Technical Assistant (on scholarship)
Mahboob Elahi	M. Sc.	Technical Assistant (on study leave)
Mohammad Salim	M. Sc.	Technical Assistant
Jamil-ur-Rahman	M. Sc.	Technical Assistant
Abdul Sattar	M. Sc.	Technical Assistant
Zahoor-ud-Din	M. Sc.	Technical Assistant
Munir Ahmad	B. Sc. (Hons)	Technical Assistant
Mushtaq Ahmad Chatta	M. Sc.	Technical Assistant
Mansoor Ahmad	M. Sc.	Technical Assistant
Abdul Majid Hamid	M. Sc.	Technical Assistant
Nazar Mohammad	M. Sc.	Technical Assistant
Mohammad Akram Sandhu	M. Sc.	Technical Assistant
Ilyas Ahmad	M. Sc.	Technical Assistant
Abdul Haq	M. Sc.	Technical Assistant
Aftab Beg Chughtai	M. Sc.	Technical Assistant
Muhammad Yaqub	M. Sc.	Technical Assistant
Abdul Rashid	M. Sc.	Technical Assistant
Javaid Masood Butt	M. Sc.	Technical Assistant
Mohammad Ashraf	M. Sc.	Technical Assistant
Mohammad Hanif	M. Sc.	Technical Assistant
Akhtar Ali Saddal	B. Sc.	Junior Technical Assistant (on scholarship)

Food Research Division

M. H. Hashmi	Ph. D.	Senior Research Officer
Ehsan Ali	M. Sc.	Research Chemist (on study leave)
Manzoor Elahi	M. Sc.	Technical Assistant (on scholarship)
Qazi Qamarul Huda	M. Sc.	Technical Assistant (on scholarship)
Mahmoodul Hassan	M. Sc.	Technical Assistant
Abdul Bari Latif	M. Sc.	Technical Assistant
Abdul Majid Nadeem	M. Sc.	Technical Assistant
Abdul Rashid	M. Sc.	Technical Assistant
Sh. Arshad Saeed	M. Sc.	Technical Assistant
Mohammad Sarwar	M. Sc.	Technical Assistant
Mohammad Umar	B. Sc.	Junior Technical Assistant

Industrial Fermentation Division

Ahmad Kamal	M.Sc.,Ph.D. (Liverpool)	Head of Division
Mohammad Saeed	M. Sc.	Research Officer (on scholarship)
S. R. H. Rizvi	M. Sc.	Technical Assistant (on study leave)
Maqsood Ali Wahid	M. Sc.	Technical Assistant
A. F. M. Ehtishamuddin	M. Sc.	Technical Assistant (on scholarship)
M. Abdul Qadeer	M. Sc.	Technical Assistant (on scholarship)
Mohammad Afzal Malik	M. Sc.	Technical Assistant (on study leave)
Mohammad Aqil	M. Sc.	Technical Assistant
Mohammad Yunis	M. Sc.	Technical Assistant
Anwar-ul-Haq	M. Sc.	Technical Assistant
Mohammad Yasin	M. Sc.	Technical Assistant
Asad Ali Sheikh	M. Sc.	Technical Assistant
Sajjad Hussain	M. Sc.	Technical Assistant
Salim Ahmad	M. Sc.	Technical Assistant
Muhammad Nazir	M. Sc.	Junior Technical Assistant

Physics and Electronics Section

M. H. Usmani	M. Sc.	Research Officer (on scholarship)
Karam Elahi	M. Sc.	Research Chemist (on study leave)
Abdul Rauf Anwar	M. Sc.	Research Physicist
Abdul Waheed	M. Sc.	Technical Assistant (on scholarship)
Saif-ur-Rahman	M. Sc.	Technical Assistant (on study leave/scholarship)
Manzoor Mehdi Khan	M. Sc.	Technical Assistant

Glass and Ceramics Division

F. A. Farooqi	Ph.D.(London), D.I.C.	Senior Research Officer
M. Safdar	Ph. D.	Senior Research Officer
Azizul Haq	M. Sc.	Research Chemist
Mohammad Ibrahim	M. Sc.	Research Chemist (on study leave)
Masood Ahmad Beg	M. Sc.	Technical Assistant (on study leave)
Mohammad Hanif Qureshi	M. Sc.	Technical Assistant
Saeeduddin Sindhu	M. Sc.	Technical Assistant
Mohammad Yasin II	M. Sc.	Technical Assistant
Ghulam Rasul	M. Sc.	Technical Assistant (on study leave)
Shakil Ahmad	M. Sc.	Technical Assistant
Ahmad Din	M. Sc.	Technical Assistant
Riaz Ali Khan	M. Sc.	Technical Assistant
Mushtaq Ahmad Naz	M. Sc.	Technical Assistant
Naweed-ul-Islam	M. Sc.	Technical Assistant
Khalid Farooqi	M. Sc.	Technical Assistant
Mahmood Akbar	M. Sc.	Technical Assistant
Arshad Ali Naqvi	M. Sc.	Technical Assistant

Nutrition Section

Rahmatullah Qureshi	M.Sc.,Ph.D. (London)	Senior Research Officer (on training)
S. M. Ali	Ph. D.	Senior Research Officer

Mohammad YaSsi	M. Sc.	Research Officer
Farrakh Hnassan hah	M. Sc.	Research Chemist (on scholarship)
Abdul Sattar Alavi	M. Sc.	Technical Assistant
Iftikhar Ali I	M. Sc.	Technical Assistant
Habib Ullah	M. Sc.	Technical Assistant
Abdul Rauf Aziz	M. Sc.	Technical Assistant
Abdul Razzak Ahmad	M. Sc.	Technical Assistant
Muhammad Yusaf	M. Sc.	Technical Assistant
Mohammad Jamil	M. Sc.	Technical Assistant
Mohammad Arshad	M. Sc.	Technical Assistant
Mohammad Ishaq	M. Sc.	Technical Assistant
Iftikhar Ali II	M. Sc.	Technical Assistant
Miss Aziz Syed	M. Sc.	Technical Assistant
Miss Siraj Fatima	M. Sc.	Technical Assistant
Miss Zahida Begum	M. Sc.	Technical Assistant
Yousaf Ikram-ul-Haq	B. Sc.	Junior Technical Assistant

Administration

B. A. Sajid	B.A. (Hons) Dip. Journalism, Cert. Russain.	Administrative Officer
Fateh Mohammad	M. A.	Accounts Officer (Part-time)
M. H. Z. Alavi	M. A.	Asstt. Administrative Officer
S. W. Zaman	B.A. (Hons)	Estate Superintendent

Engineering

Mian Badar-ud-Din	M. A.	Technical Officer

Stores

Mian Mohammad Sharif	M. Sc.	Technical Officer

Workshop

Jamil Ahmad Jaffri	B. Sc. (Engg.)	Technical Assistant (on study leave)

Library

Nazir Ahmad	B. Sc.	Librarian

NORTH REGIONAL LABORATORIES

Indigenous Drug Research Division

(a) Chemistry Section

S. A. Warsi	M. Sc., Ph. D. (Pb.), Ph. D. (Wales)	Head of Division (Acting Director)
M. Kiamuddin	Ph. D. (Alig), Ph. D. (London)	Principal Scientific Officer
M. Ikram	M. Sc. Ph. D. (Italy)	Senior Research Officer
M. A. Wahid	M. Sc.	Research Officer
G. A. Miana	M. Sc.	Research Chemist
A. K. K. M. Musharraf Hussain	M. Sc.	Technical Assistant
M. Ehsanul Haque	M. Sc.	Technical Assistant
Salahuddin Masood	M. Sc.	Technical Assistant
M. Islam	B. Sc.	Junior Technical Assistant
Khuda Bux	B. Sc.	Senior Laboratory Assistant
Wasif Hussain	B. Sc.	Senior Laboratory Assistant
Abdul Hamid Khan	B. Sc.	Senior Laboratory Assistant
M. Jehangir	B. Sc.	Senior Laboratory Assistant
Ashraf Hussain	B. Sc.	Senior Laboratory Assistant
Abdul Khaliq Chaudhry	B. Sc.	Senior Laboratory Assistant
M. Aslam	B. Sc.	Senior Laboratory Assistant

(b) Botany Section

N. A. Malik	M. Sc.	Research Botanist
S. M. Kazmi	B. Sc.	Technical Assistant
Dost Mohammad Khan	M. Sc.	Technical Assistant
Miss Saddiqua A. R.	M. Sc.	Technical Assistant
Iftikhar Hussain	B. Sc.	Senior Laboratory Assistant
Bashir Hussain Shah	B. Sc.	Senior Laboratory Assistant
Arif Jameel Ahmad	B. Sc.	Senior Laboratory Assistant

(c) Pharmacology Section

H. K. M. Abdul Hye	M.B.B.S.	Research Officer

A. Q. S. Bukhari	M.B.B.S.	Research Officer
Yousuf Qamar	M.B.B.S.	Research Officer
A. R. Sahibzada	M.B.B.S.	Research Officer
Sahib Gul		Senior Laboratory Assistant

Mineralogy Division

M. Nabi Bakhsh	M.Sc., M.S. (M.I.T., U.S.A.)	Senior Research Officer
M. A. K. Khattak	M. Sc.	Research Chemist
Fazal Mohammad	M. Sc.	Technical Assistant
Mohammad Amin	M. Sc.	Technical Assistant
Rab Nawaz	M. Sc.	Technical Assistant
M. Iqbal Anwar Khan	M. Sc.	Technical Assistant
Hassan Hadi	M. Sc.	Technical Assistant
Mohammad Younis	B. Sc. (Hons)	Junior Technical Assistant
M. Allauddin	B. Sc.	Senior Laboratory Assistant
Bashir Ahmad	B. Sc.	Senior Laboratory Assistant
Zakirullah	B. Sc.	Senior Laboratory Assistant

(a) Geology Section

M. A. K. Yusufi	M.Sc., D.E.S. (Ncy) A.S.T. E.F. (Dy) Paris	Research Officer
Sharafuddin Ahmad	M. Sc.	Technical Assistant
Sardar Mohammad Naqvi	M. Sc.	Technical Assistant
Mohammad Javid	B. Sc.	Senior Laboratory Assistant
F. A. Siddiqui	B. Sc.	Senior Laboratory Assistant

(b) Chemical Section

Saadat Ali Khan	B.Sc. (Chem. Eng.)	Research Officer
Fakhrul Haq	B. Sc.	Senior Laboratory Assistant

F. T. Division

M. B. Bhatti	M. Sc. (Agri. Chem)	Research Officer
J. N. Khattak	B. Sc., Cert. Fruit Tech. (N.S. Wales)	Research Chemist

Samiullah	M. Sc.	Research Chemist
N. A. Sufi	M. Sc.	Research Chemist
Fazalur Rehman	M. Sc.	Technical Assistant
Ali Asghar	M. Sc. (Agri.)	Technical Assistant
Mohammad Ismail	B. Sc.	Junior Technical Assistant
Abdus Sattar	B. Sc. (Agri.)	Junior Technical Assistant
Mohammad Rafiq	B. Sc. (Agri.)	Junior Technical Assistant
M. Ismail Siddiqi	B. Sc. (Agri.)	Senior Laboratory Assistant
Abdul Jabbar	B. Sc.	Senior Laboratory Assistant
Naeem Ahmad	B. Sc.	Senior Laboratory Assistant
Ahmad Khan	B. Sc.	Senior Laboratory Assistant
Mazhar Hussain	B. Sc.	Senior Laboratory Assistant

Wool Division

Arbab Abdul Wakil	Dip. Wool Tech. (Australia)	Research Technologist
Maqsood Ali Shah	M. Sc.	Research Chemist
Mumtaz Ahmad	M. Sc.	Research Physicist
Faizullah Khan	M. Sc.	Technical Assistant
Taj Ali Wazir	M. Sc.	Technical Assistant
Arjamand Khan	M. Sc.	Technical Assistant
Amir Mohammad	B. Sc.	Senior Laboratory Assistant
Abdul Khaliq	B. Sc.	Senior Laboratory Assistant
M. Iqbal Khattak	B. Sc.	Senior Laboratory Assistant
Akhlaq Ali Khan	B. Sc.	Senior Laboratory Assistant
Ghulam Nabi	B. Sc.	Senior Laboratory Assistant
Mian Taj Younis	B. Sc.	Senior Laboratory Assistant

Administration

A. K. U. Deshmukh	B.A., LL.B.	Administrative Officer
A. S. H. Haqqani	B.A., LL.M.	Superintendent

Engineering Section

Ch. Mohammad Tufail		Assistant Engineer

Library

Umar Khitab	B. Sc.	Senior Library Assistant

Stores

Rana Ahmad Khan	B. Sc.	Stores Officer

Workshop

Mohammad Zaman Iqbal	Foreman
Nawab Ghulam Khan	Senior Technician

APPENDIX (C)

PUBLISHED PAPERS, BIBLIOGRAPHIES AND TRANSLATIONS

PUBLISHED PAPERS

(a) ORGANIC CHEMISTRY INCLUDING PLANT PRODUCTS

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280.	Tannins from Tea & Tobacco Waste (31 Refs.)
281.	Broadcast Transmitters—Synchronized Operation (15 Refs.)
282.	Potato—Culture, Diseases, etc. (Books & Pamphlets only) (36 Refs.)
283.	Psoriasis—Treatment (17 Refs.)
284.	Radio Antenna and Transmission Lines—Design, Installation, etc. (61 Refs.)
285.	Wheat-NPK Fertilizer Requirements (45 Refs.)
286.	Electrolytes: (a) Normal balance; (b) Disturbance in Congestive Heart-failure (25 Refs.)
287.	Quinacrine Hydrochloride—Clinical Aspects (42 Refs.)
288.	Genus Beroe (Phyl.: Coelentrata, sub. Phyl.: Ctenophora)—Taxonomy (32 Refs.)
289.	Oceanography (General References: Bibliographies, Journals, Books and Monographs, Institutions) (83 Refs.).
290.	Caffey's Disease (with special reference to ossification in muscles in Paraplegia) (17 Refs.)
291.	Reinforced Concrete Water Tanks (23 Refs.)
292.	Use of Radio Isotopes in Forestry and Forest Products (28 Refs.)

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293. Periodicals on pure and applied Botany, Pharmacy and Allied subjects published from U.K. and U.S.A. (50 refs.)

294. Cold abscess of Pelvic Region (19 Refs.)

295. Toilet soap manufacture (Books and Periodicals) (12 Refs.)

296. Contribution of ancient Hindus to the Science of Hydrology, Irrigation, etc. (27 Refs.)

297. Paper Mill Effluents and their Effect on Fish Life (42 Refs.)

298. Lymphogranuloma Vonereum (Indian References) (10 Refs.)

299. Photometry of the Moon (18 Refs.)

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315. Water Hyacinth (*Eichhornia crassipes*)—Utilization (29 Refs.)

316. Phosphate Fixation in Soils (with special reference to presence or absence of Amonium Sulphate) (24 Refs.)

317. Fishing Net Manufacture from Cotton Twine (including (a) Rot-proofing, (b) Acetylation and Cyano-ethylation) (46 Refs.)

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321. *Vinca rosea*, L.—Medicinal Properties (26 Refs.)

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324. Blood Transfusion (120 Refs.)

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335. Industrial Toxicology of Sulphur (32 Refs.)

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337. Seed Dormancy (31 Refs.)

338. Fertilizer Trials—Field (69 Refs.)

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APPENDIX (D)

(a) P. C. S. I. R. SECRETARIAT

Dr. Salimuzzaman Siddiqui	Chairman
A. H. Chotani	Secretary

(*i*) *Administration*

M. A. Salam	Assistant Secretary
Zahuruddin	Assistant Secretary
Masud Ahmad Khan	Assistant Secretary
Habib Ahmad	Assistant Secretary
S. A. Rahman	Accounts Officer
S. Raza Hussaini	Personal Secretary to Chairman
Shujauddin	Assistant Executive
M. A. Bhatti	Superintendent
S. M. Imtiaz	Superintendent
S. A. Qadri	Superintendent
Absar Ahmad	Superintendent
Rafiq Ahmad	Superintendant
Mir Afzal Ali	Superintendent
Mohammad Iqbal	Superintendent
M. S. Qureshi	Superintendent

(*ii*) *Publications and Patents*

M. A. Haleem	Senior Scientific Officer
K. M. Habib	Scientific Officer
Azim Kidwai	Editor (English Magazine)
Azmat Ali Khan	Editor (Urdu Magazine)
Makboolur Rahman	Editor (Bengali Magazine)
M. Yaqub Khan	Sub-editor
A. Abdul Hameed	Sub-editor

KHWAJA KAMALUDDIN	Scientific Assistant
A. FAYAZUDDIN	Technical Assistant

(*iii*) *Engineering*

ABDUS SAMAD KHAN	Senior Engineer
T. A. SHEIKH	Civil Engineer

(b) FINANCE

Annual Budget

The year-wise budget provisions for the Council are as shown below:

July 1961—June 1962	.....	1,30,00,000
July 1962—June 1963	.....	1,32,00,000

Sr. No.	Budget Grant	Head of Account	Council's Sectt., Karachi	Central Lab Karachi
1.	9,23,000	Pay of Officers	90,235.63	4,26,926.
2.	14,80,000	Pay of Establishment	2,97,779.39	5,72,383.
3.	7,95,000	Allowance & Honorarium ...	1,81,284.25	3,42,721.
		Total Pay & Allowances ...	5,69,299.27	13,42,032.
4.	20,00,000	Other Charges		
	(A)	**Capital Expenditure**		
I.		Acquisition & Development of lands	—	—
II.		First Phase of Planning Construction, Equipment & Tools ...	—	3,98,519.
III.		Construction of Quarters ...	—	888.
	(B)	**Running Expenditure**		
IV.	53,000	Addition & Alteration to Existing Premises	8,904.88	9,200.
V.		Furniture, Fixture & Fittings ...	5,678.00	4,725.
VI.	91,000	Laboratory Apparatus	—	81,427.
VII.	4,000	Pilot Units Process Equipments ...	—	469.
VIII.	5,000	Construction of Pilot Plants Sheds	—	—
IX.	48,000	Scientific Books & Journals ...	—	20,888.
X.	1,16,000	Chemicals, Solvents & Raw Materials	—	54,673.
XI.	75,000	Workshop Equipments & Tools ...	—	1,33,920.
XII.	15,000	Rents of Buildings Labs. ...	19,200.00	378.
XIII.	1,000	Gas Plant Petrol	—	—
XIV.	4,55,000	Miscellaneous Contingencies ...	1,90,361.94	3,19,761.
XV.	20,00,000	Foreign Purchases	19,72,949.11	—
XVI.	2,20,000	Clearance of Imported Goods ...	1,47,662.71	—
XVII.	42,000	Purchase of UNESCO Coupons ...	—	—
XVIII.		Income Tax payable by the Council on behalf of the Foreigners in the service of Council ...	9,758.28	

NNUAL STATEMENT OF ACCOUNT FOR 1960—61 (July 1960 to June 1961)

DITURE

Pansdoc, Karachi	W.R. Labs, Lahore	E.R. Labs., Dacca	N.R. Labs., Peshawar	Total		Excess and Saving
67,126.24	1,49,162.57	1,79,669.96	72,123.28	9,85,244.65	(+)	62,244.65
45,549.79	3,90,140.70	2,48,342.90	1,14,087.19	16,68,283.31	(+)	1,88,283.31
33,689.78	1,68,520.38	1,14,538.10	77,010.73	9,17,764.97	(+)	1,22,764.97
1,46,365.81	7,07,823.65	5,42,550.96	2,63,221.20	35,71,292.93	(+)	3,73,292.93
-	76,165.93	12,706.11	—	88,872.04		
-	9,25,108.50	14,55,146.11	5,30,816.36	13,09,590.29	(+)	13,99,350.33
-	- -	-	---	888.00		
2,428.12	3,732.25	--	23,283.41	47,548.66		
2,808.99	1,97,950.94	23,379.50	—	2,34,542.43	(+)	2,29,091.09
	1,07,111.42	71,302.65	9,835.12	2,69,677.07	(+)	1,78,677.07
-	-	-	- -	469.25	(—)	3,530.75
—	- -	—	—	- -	(—)	5,000.00
2,600.51	36,185.65	18,348.78	11,135.83	89,158.99	(+)	41,158.99
—	61,691.18	4,897.56	6,441.65	1,27,703.95	(+)	11,703.95
2,019.36	24,135.44	61,552.06	2,658.04	2,24,285.23	(+)	1,55,558.23
1,575.00	--	—	—	21,153.00	(+)	6,153.00
—	932.93	—	876.47	1,809.40	(+)	809.40
26,465.46	1,28,715.30	84,710.51	1,07,657.37	8,57,672.44	(+)	4,02,672.44
—	—	—	—	19,72,949.11	(—)	27,050.89
—	—	81,988.24	13,093.50	2,42,744.45	(+)	22,744·45
—	—	—	—	—	(—)	42,000.00
—	—	—	—	9,758.28		—

Sr. No.		Budget Grant	Head of Account	Council's Sectt., Karachi	Central Lab Karachi
	XIX.	5,000	Printing of Journals	—	—
	XX.	1,30,000	Expenditure on UNESCO Experts...	1,13,446.00	—
	XXI.		Indelible Ink Account	64,674.87	—
5.		25000.00	Social Welfare Fund	100.00	6,277.0
6.		80,000	Provision for Scientific Research Scheme	34,176.00	—
7.	*I*	70,000	Science Conference, Symposium & Seminars...	—	—
	II	10,000	Delegation to Foreign Countries	41,620.47	—
8.		40,000	Award of Fellowship, Scholarship and Study Leave	12,546.67	—
9.		23,000	Pension & Leave Salary Contribution	13,189.48	—
10.		1,20,000	Council Contribution towards C. P. Fund	1,86,169.94	—
			Total of Other charges ...	28,20,439.02	10,31,128.4
11.		14,000	**Deposits & Advances**		
	I		Cycle Advance	7,250.00	5,000.0
			Less Recoveries ... ...(—)	4,783.54	(—) 4,565.0
			Net	2,466.46	434.9
	II	80,000	Motor Car/Motor Cycle advance ...	36,469.50	33,577.0
			Less Recoveries ... (—)	25.409.92	(—) 24.383.9
			Net	11,059.58	9,193.0
	III		House Repair Advance ...	16,766.55	30,649.4
			Less Recoveries	—	—
	IV		Objection Book Advance ...	—	—
	(A)		Gazetted Officers		
	(B)		Non Gazetted		
	(C)		Miscelaneous Advances Adjustable...		
			Secretariat		
			Central Laboratories		
			PANSDOC		
	(D)		Special Advances Drawn in Cash	20,472.60	—
			Total Deposits & Advances ...	50,765.19	40,277.3

Pansdoc, Karachi	W. R. Labs., Lahore	E. R. Labs., Dacca	N. R. Labs., Peshawar	Total	Excess and Saving
—	—	—	—	—	(—) 5,000.00
—	—	—	—	1,13,446.00	(—) 16,554.00
—	—	—	—	64,674.87	—
—	—	—	3,607.40	9,984.40	(—) 15,015.60
697.25	—	—	—	34,873.92	(—) 45,126.08
—	—	—	—	—	(—) 70,000.00
—	—	4,876.73	—	46,497.20	(+) 36,497.20
—	—	—	—	12,546.67	(—) 12,453.33
—	—	—	—	20,148.18	(—) 2,851.82
—	6,958.70	—	—	1,86,169.94	(+) 66,169.94
38,594.69	15,68,688.24	18,18,908.25	7,09,405.15	79,87,163.77	(+) 25,50,586.09 (—) 2,44,582.47
1,750.00	3,840.00	1,390.00	2,200.00	21,430.00	(+) 7,430.00
(—)1,371.81	(—)4,914.20	(—)818.00	(—)2,046.00	(—)18,498.64	—
378.19	(—)1,074.20	572.00	154.00	2,931.36	—
14,457.00	19,794.00	—	1,290.00	1,05,587.50	(+) 25,587.50
(—)2,856.18	(—)13,550.00	(—)899.75	(—)3,186.98	(—)70,286.80	—
11,600.82	6,244.00	(—)899.75	(—)1,896.98	35,300.70	—
121.00	—	—	—	47,536.99	—
—	—	—	—	—	—
—	—	1,410.00	5,523.43	6,933.43	—
—	—	—	—	20,472.60	—
12,100.01	5,169.80	1,082.25	3,780.45	1,13,175.08	(+) 33,017.50

Sr. No.	Budget Grant	Head of Account	Council's Sectt., Karachi	Central Labs., Karachi
12.	60,000	Building Research Station ...	—	72,767.97
13.		Reserve Funds	—	—
14.	20,000	Grant to Scientific Commission ...	13,000.00	—
15.		PIOSA	43,917.93	(—) 20.00
	90,00,000	Total Service Heads	34,97,421.41	24,86,185.81
		Total all Heads	—	—
		Secretariat	—	—
		Central Laboratories	—	—
		PANSDOC	61,80,647.73	—
16.		Closing Balance	2,33,062.69	—
		Grand Total	64,13,710.42	—

(M. S. Qureshi)
Supdt, Accounts Branch,
P. C. S. I. R.

(S. A. Rehman)
Accounts Officer,
P. C. S. I. R.

Pansdoc, Karachi	W.R. Labs., Lahore	E. R. Labs., Dacca	N. R. Labs., Peshawar	Total	Excess and Saving
—	—	—	—	72,767.97	(+) 12,767.97
—	—	—	—	—	—
—	—	—	—	13,000.00	(—) 7,000.00
(—)20.00	—	2,176.31	—	46,054.24	—
1,97,040.51	22,81,681.69	23,64,717.77	9,76,406.80	1,18,03,453.99	(+) 29,69,664.49 (—) 2,51,582.47
—	—	—	—	—	—
—	—	—	—	—	—
—	—	—	—	—	—
—	—	—	—	—	—
—	75,889.53	7,20,494.34	3,64,929.62	13,94,376.18	—
—	23,57,571.22	30,85,212.11	13,41,336.42	1,31,97,830.17	—

(A. H. Chotani)
Secretary,
P. C. S. I. R.

S. No.	GRANT Original	GRANT Net		Head of Account	Council's Secretariat, Karachi	Central Laboratories Karachi
1.	1015000.00	1210000.00		Pay of Officers	118564.34	474560.94
2.	1550000.00	2000000.00		Pay of Establishment	292612.63	641898.33
3.	1035000.00	1235000.00		Allowances & Honoraria	227938.79	451726.70
				Total of Pay & Allowances	639115.76	1568186.03
4.				**Other Charges**		
			"A"	**Capital Expenditure**		
	—	500000.00	*i)*	Acquisition & Development of lands	—	
	1900000.00	2500000.00	*ii)*	1st Phase of Planning Construction, Equip. & Tools	—	398064.20
			iii)	Construction of Quarters	—	149896.1
			"B"	**Running Expenditure**		
	—	19000.00	*iv)*	Addition & Alteration of Existing Premises	11993.75	8285.71
	20000.00	110000.00		Furniture, Fixture & Fitting	12783.00	26970.0
	55000.00	300000.00	*v)*	Labs. Apparatus & Appliances	—	112145.3
	—	170000.00	*vi)*	Construction of Pilot Plant Shed	—	165312.1
	—	5000.00	*vii)*	Pilot Plant Unit Process Equipment	—	4481.9
	76000.00	102000.00	*viii)*	Scientific Books & Journals	21.25	42415.5
	61000.00	175000.00	*ix)*	Chemical Solvents & Raw Materials		89494.8
	80000.00	229848.00	*x)*	Workshop Equipment & Tools	2150.00	110617.6
	36000.00	50000.00	*xi)*	Rent, Building Labs. & Premises etc	19200.00	11372.4
	2000.00	8000.00	*xii)*	Gas Plant Petrol		1772.0
	570000.00	1118000.00	*xiia)*	Misc. Contingencies	196035.85	511848.2
	2700000.00	2700000.00	*xiii)*	Foreign Purchases	2388677.33	
	55000.00	466000.00	*xiv)*	Clearance of Imported Goods, Customs Duty & Sale Tax etc	396542.10	—
	40000.00	20000.00	*xv)*	Purchase of UNESCO Coupons	—	—
	—	—	*xvi)*	Income Tax payable by the Council on behalf of Foreigners in the service of Council.	5546.71	—

ANNUAL STATEMENT OF ACCOUNT FOR 1961—62 (July 1961 to June 1962).

DITURE

Pansdoc, Karachi	West Regional Laboratories, Lahore	East Regional Laboratories, Dacca	North Regional Laboratories, Peshawar	Total	(—) (+)	Saving Excess
65392.89	171807.19	219948.30	101123.80	1151397.46	(—)	58602.54
45244.84	471537.83	330164.77	173095.06	1954553.46	(—)	45446.54
43079.98	220961.83	152261.16	111102.78	1207071.30	(—)	27928.70
153717.71	864306.85	702374.23	385321.64	4313022.22	(—)	131977.78
—	73939.44	25341.48	—	99280.92	(—)	400719.08
—	484040.68	799795.80	375525.48	2057426.16	(—)	292677.73
—	—	—	—	149896.11		
16275.00	356.83	—	20765.61	57676.98	(+)	38676.98
275.00	111714.69	36820.42	16370.00	204933.11	(+)	94933.11
—	65057.27	63315.50	54425.95	294944.04	(—)	5055.96
—	—	—	—	165312.10	(—)	4687.90
—	—	—	—	4481.97	(—)	518.03
699.73	29677.08	350.94	12870.88	86035.39	(—)	15964.61
1235.96	46695.05	7696.27	17526.48	162648.59	(—)	12351.41
9721.47	3460.20	111543.77	14530.29	252023.41	(+)	22175.41
13954.53	—	—	—	44526.98	(—)	5473.02
—	3202.31	—	1357.80	6332.11	(—)	1667.89
38864.79	165552.15	114636.00	104907.39	1131844.45	(+)	13844.545
—	—	366274.87	—	2754952.20	(+)	54952.20
—	—	90908.93	6316.29	493767.32	(+)	27767.32
19619.44	—	—	—	19619.44	(—)	380.56
—	—	—	—	5546.71	(+)	5546.71

S. No.	GRANT Original	GRANT Net	Head of Account	Council's Secretariat, Karachi	Central Laboratories, Karachi
	5000.00	40000.00	*xvii*) Printing of Journals ...	31596.05	—
	20000.00	5000.00	*xviii*) Expenditure on UNESCO Experts	1642.00	—
			xix) Indelible Ink Accounts.	—	—
5.	25000.00	25000.00	Social Welfare Fund ...	3040.00	6000.00
6.	20000.00	30000.00	Provision for Scientific Research Scheme ...	29000.00	—
7.	30000.00	30000.00	*i*) Delegation to Foreign Countries	38246.73	—
		5000.00	*ii*) Science Conference, Symposium & Seminars. ...	4542.00	—
8.	30000.00	35000.00	Award of Fellowship/Scholarship/Study Leaves ...	15878.00	—
9.	15000.00	10000.00	Pension & Leave Salary Contribution	10357.66	—
10.	120000.00	230000.00	Council's Contribution towards C. P. Fund ...	226768.00	—
11.	—	—	Council's Contribution towards House Rent	—	—
12.	—	10000.00	Grant to Scientific Bodies and Association	18000.00	—
13.	98000.00	98000.00	Provision of Award for New Process & Inventors.	—	—
14.	—	500000.00	Natural Drugs Research Institute, Chittagong	—	—
			Total of Other Charges ...	3412020.43	1638676.23
15.	—	—	Deposit & Advances		
	14000.00	28000.00	*i*) Cycle Advance	8000.00	7000.00
			Less Recoveries	3646.94	4388.00
			Net	4353.06	2612.00
	78000.00	120000.00	*ii*) Motor Car/Cycle Advn.	43310.00	38362.00
			Less Recoveries ...	27089.35	26467.71
			Net	16220.65	11894.29
	350000.00	65000.00	*iii*) House Bldg. Advance ...	40270.00	4760.00
			Less Recoveries	333.00	—
			Net	39937.00	4760.00
			iv) House Repair Advance ...	256.00	—
			Less Recoveries ...	971.00	1250.00
			Net	(—)715.44	(—)1250.00

Pansdoc, Karachi	West Regional Laboratories, Lahore	East Regional Laboratories, Dacca	North Regional Laboratories, Peshawar	Total	(—) (+)	Saving Excess
—	—	—	—	31596.05	(—)	8403.95
—	3059.91	—	—	4701.91	(—)	298.09
—	—	—	—	—		—
1705.00	8670.00	6000.00	4870.84	30285.84	(+)	5285.84
—	1076.94	5831.38	—	35908.32	(+)	5908.32
—	—	—	293.50	38540.23	(+)	8540.23
—	—	—	—	4542.00	(—)	458.00
—	—	11351.69	7148.40	34378.09	(—)	621.91
—	—	—	28499.40	38857.06	(+)	28857.06
—	—	—	—	226768.00	(—)	3232.00
—	—	—	—	—		—
—	—	—	—	18000.00	(+)	8000.00
—	—	—	—	—	(—)	98000.00
—	—	500000.00	—	500000.00		—
102350.92	996502.55	2139867.05	665408.31	8954825.49	(—)	536022.51
2000.00	1990.00	1000.00	1000.00	20990.00	(—)	7010.00
853.50	3604.00	1679.00	7085.19	21256.63		—
1146.50	(—)1614.00	(—)679.00	(—)6085.19	(—)266.63		—
8850.00	13960.00	10000.00	6400.00	120882.00	(+)	882.00
5097.12	12991.00	6914.00	1050.00	79609.18		—
3752.88	969.00	3086.00	5350.00	41272.82		—
2320.00	700.00	3060.00	—	51110.00	(—)	13890.00
—	—	—	—	333.00		—
2320.00	700.00	3060.00	—	50777.00		—
—	—	—	—	256.00	(+)	256.00
361.00	—	—	66.00	2648.44		—
(—)361.00	—	—	(—)66.00	(—)2392.44		—

S. No.	GRANT Original	GRANT Net	Head of Account	Council's Secretariat, Karachi	Central Laboratories, Karachi
			v) Objection Book Adv. ...	1440.00	—
			a) Gazetted Officers ...	—	—
			b) Non-Gazetted	—	—
			c) Special Advance in Cash Subject to adjustment ...	8284.85	—
		20000.00	*d*) Advance to National Science Council ...	18107.74	—
			Total Deposits & Advances ...	88627.86	18016.29
16.			Building Research Station ...	—	—
17.			Reserve Fund	—	—
18.			Grants to Scientific Commission ...	276.00	—
19.		1000.00	PIOSA	11169.69	—
10000000.00		14169848.00	Total Service Heads ...	4151209.74	3224878.55
			Combined Total Service Heads. Council's Sectt., Central Labs., Pansdoc, Karachi ...	7639015.30	—
20.			Closing Balance	148331.18	—
			Grand Total	7787346.48	—

(Rafique Ahmad)
Supdt. Acctt. II Branch.,
P. C. S. I. R., Karachi.

(S. A. Rehman)
Accounts Officer,
P. C. S. I. R. Karachi.

Pansdoc, Karachi	West Regional Laboratories, Lahore	East Regional Laboratories, Dacca	North Regional Laboratories, Peshawar	Total	(—) (—)	Saving Excess
—	—	—	—	1440.00	(+)	1440.00
—	—	—	—	—		—
—	—	—	—	—		—
—	—	—	16091.79	24376.64	(+)	24376.64
—	—	—	—	19107.74	(—)	892.26
6858.38	55.00	5467.00	15290.60	134315.13	(+)	5162.38
—	—	—	—	—		—
—	—	—	—	—		—
—	—	—	—	276.00	(+)	276.00
—	—	(—)89.96	—	11079.73	(+)	10079.73
262927.01	1860864.40	2847618.32	1066020.55	13413518.57	(—)	652482.18
—	—	—	—	—		—
—	579634.10	224739.68	39345.62	992050.58		—
—	2440498.50	3072358.00	1105366.17	14405569.15		—

(A. H. Chotani)
Secretary,
P. C. S. I. R.

APPENDIX (E)

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14. Aftab Hassan, B.Sc. (Hons.), M. Sc., B. Sc., Director, Bureau of Composition, Compilation and Translation, University of Karachi, & Recog. Reader in Chemistry, University of Karachi, Karachi (*Co-editor*).

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